LAWS OF WAGES

THE MACMILLAN COMPANY
NEW YORK · BOSTON · CHICAGO
SAN FRANCISCO

MACMILLAN & CO., LIMITED
LONDON · BOMBAY · CALCUTTA
MELBOURNE

THE MACMILLAN CO. OF CANADA, LTD.
TORONTO

LAWS OF WAGES

AN ESSAY IN STATISTICAL ECONOMICS

BY

HENRY LUDWELL MOORE

PROFESSOR OF POLITICAL ECONOMY IN COLUMBIA UNIVERSITY

"Il progresso dell' Economia politica dipenderà pel futuro in gran parte dalla ricerca di leggi empiriche, ricavate dalla statistica, e che si paragoneranno poi colle leggi teoriche note, o che ne faranno conoscere di nuove."

PARETO.

New York

THE MACMILLAN COMPANY

1911

Set up and electrotyped. Published December, 1911.

Norwood Press
J. S. Cushing Co. — Berwick & Smith Co.
Norwood, Mass., U.S.A.

TO

JOHN BATES CLARK

IN ADMIRATION AND AFFECTION

I DEDICATE THIS ESSAY

CONTENTS

PAGE

Introduction 1

CHAPTER I

STATISTICAL LAWS

A Scatter Diagram 11
Definition of Terms 15
Characteristics of Statistical Laws 21

CHAPTER II

WAGES, MEANS OF SUBSISTENCE, AND THE STANDARD OF LIFE

Description of Data 26
Wages and the Means of Subsistence 29
Wages and the Standard of Life 33
Wages of Skilled and of Unskilled Laborers 39

CHAPTER III

WAGES AND THE PRODUCTIVITY OF LABOR

Description of Data 45
Fluctuations in the Rate of Wages and in the Value of the Product 46
Fluctuations in the Laborer's Relative Share of the Product and in the Ratio of Capital to Labor 55
The General Trend of Wages 61

CHAPTER IV

WAGES AND ABILITY

PAGE
An Hypothesis as to the Distribution of Ability 74
Grounds for the Hypothesis 76
The Expression of the Gaussian Law in a Form that will facilitate the Testing of the Differential Theory of Wages . . 78
The Standard Population 82
The Application of the Theory of the Standard Population . 85
Remark upon the Preceding Demonstration 93

CHAPTER V

WAGES AND STRIKES

Outcome of Strikes as affected by the Strength of Trades-Unions 105
Outcome of Strikes as limited by Economic Law . . . 121
Summary 134

CHAPTER VI

WAGES AND THE CONCENTRATION OF INDUSTRY

Wages as affected by the Concentration of Industry . . . 140
Amount of Employment 153
Continuity of Employment 156
Length of the Working Day 161

CHAPTER VII

CONCLUSIONS

Statistical Economics and Industrial Legislation . . . 169
Practical Aspects of the Results of Preceding Chapters . . 174
Statistical Economics and Synthetic Economics 196

LAWS OF WAGES

LAWS OF WAGES

INTRODUCTION

There are five circumstances the coexistence of which at the present time will probably determine in the near future the direction and character of such economic investigations as shall have for their object the discovery of general facts and laws: —

(1) The pure theory of economic statics has reached a definite, mathematically symbolic form; it supplies a general view of the economic field, and indicates the desiderata for further theoretical inquiries.

The utility of economic theory is to be measured by the degree in which it solves its triple task of definition and analysis of concepts, the discovery of appropriate methods for handling mutually dependent social phenomena, and the presentation of a general view of the economic field. Clearness and precision of definition are absolutely indispensable to any form of quantitative work. So long as economic terms were employed with the vagueness illustrated by Jevons when he showed that in the use of the word "value" three distinct meanings were habitually confused, it "was not to be expected that we could profitably discuss such matters as economic doc-

trines."[1] The net result of the subtle discrimination and criticism of concepts which has characterized a great portion of contemporary work is that, for the first time, the inductive worker has a choice of groups of terms that are precise and clear.

In a similar manner, in quite recent years, the idea of the relations of economic phenomena has widened, and methods have been discovered that enable us to visualize these interrelations in their complexity. Economic events are not arrayed in linear connection, the one event following the other in direct series, as was frequently assumed by the classical economists. It was an idle controversy that Malthus and Ricardo conducted upon the question whether the abundance of food increases the population or the multitude of consumers increases the supply of food. Social phenomena are interrelated, are mutually dependent, and the appropriate method of treating such a form of interdependence is the use of a system of simultaneous equations in which the equations are equal in number to the unknown quantities in the problem. There are hints of this conception in the works of the earlier economists; for example, in Cournot's *Recherches sur les principes mathématiques de la théorie des richesses*, but it was missed by Jevons, as was shown by Professor Marshall in his Academy review of Jevons's *Theory of Political Economy*. Walras introduced it in an important special case in his earlier treatise. It has received

[1] W. S. Jevons: *The Theory of Political Economy*, 3d edition, p. 81.

its complete development in Professor Marshall's *Principles of Economics* and Professor Pareto's *Cours d'économie politique.*

The third part of the task of the economic theory — the presentation of a general view of the economic field — was achieved in the perfection of the method of simultaneous equations which has just been described. In a non-symbolic form, the general survey was made in the original treatise of Professor J. B. Clark.

(2) Marxian socialists have distinguished between the constructive and the destructive elements of their prophet's teachings, and are seeking to extend the theory of socialism through the development of the constructive idea in the light of concrete data. The real beginning of a "scientific socialism" was in Bernstein's confession: "Die Fortentwicklung und Ausbildung der marxistischen Lehre muss mit ihrer Kritik beginnen. Heute steht es so, dass man aus Marx und Engels alles beweisen kann."[1] It was a considerable step toward "industrial emancipation" for leading socialists like Bernstein and Sorel to recognize the vagueness, inconsistency, and inadequacy of Marx's teachings; it was a greater stride in the same direction to face the necessity of attacking anew the old problems and to decide to conduct further inquiries upon the basis of concrete facts. The newer "scientific socialism" will rest upon

[1] Ed. Bernstein: *Die Voraussetzungen des Sozialismus und die Aufgaben der Sozialdemokratie*, p. 19.

formulæ derived from experience: "Je propose de nommer *économie concrète* la science moderne qui se fonde, à la fois sur l'observation directe des faits et sur la connaissance des théories abstraites qui lui permettent de comprendre l'emploi que l'on peut faire des concepts."[1] The aim of modern theoretical socialism thus described by Sorel is the aim of modern economics.

(3) The growth of social democracy has led to measures of industrial reform whose administration requires the periodic collection of varied statistics upon a large scale. Reforms in measures of taxation, where the reforms are genuine, now, for the first time, give a definite idea as to the amount of the wealth of nations and its yield of earned and unearned incomes. Reforms in the character of industrial insurance and in government reports as to the condition of labor now give detailed information as to the distribution of wages, the cost of living among laborers, the causes and seasons of unemployment, the relative frequencies and causes of industrial disputes, the prevalence of diseases among workers, and the disabilities of old age. The material for the concrete treatment of economic questions is being supplied yearly in increasing abundance.

(4) The problems of natural science have required the invention of a calculus of mass phenomena that will probably yield its best results when applied to the material of the social sciences. The wealth of

[1] Georges Sorel: *Introduction à l'économie moderne*, p. 28.

the statistical material relating to economic questions is itself a source of embarrassment. To utilize it for scientific purposes, it must be described in brief, summary formulæ, and these formulæ must be arranged upon a plan of increasing complexity so that it will be possible to pass from accurate descriptions of mass aggregates to the relations between the aggregates themselves. Now, concurrently with the development of economic and socialistic theory and the increasing supply of statistical data, the mathematical instrument for rendering the statistical data available for scientific purposes has been perfected. The calculus of mass phenomena, like the infinitesimal calculus, owes its development to many workers, but, in recent years, its efficiency has been increased by the labors of Professor Pearson and Professor Edgeworth far more than during the whole period intervening since the days of Laplace and Gauss. There is reason for believing that, as the science of statistics had its origin in the treatment of social questions, so likewise the newer statistical methods will yield their most important results when applied to social data.

(5) The perfection of mechanical devices for performing mathematical computations has rendered it possible for individual scientists to elaborate the new data supplied by government bureaus. When a science is in its early stages, individual scientists must do work of many kinds. For some years to come all essays in the direction of connecting economic

theory with economic practice must be tentative, for the investigator must at the same time master the theory, collect the facts, and take from them their content by means of new and difficult methods. With the mass of data before him, the task would be impossible without mechanical aids to computation. These aids are being supplied in increasing numbers and value in the form of mathematical tables, mechanical tabulators, and arithmometers.

In the following chapters I have endeavored to use the newer statistical methods and the more recent economic theory to extract, from data relating to wages, either new truth or else truth in such new form as will admit of its being brought into fruitful relation with the generalizations of economic science.

The first chapter contains a description of the meaning of the terms representative fact, hypothesis, statistical law, which are the principal categories by means of which scientific results are classified. In order to secure a wise expenditure of capital and energy, it is necessary in economic science as in economic affairs to make, from time to time, an inventory of one's possessions, and to this end it is all important that there should be no ambiguity about the table of values by means of which the inventory is effected. In particular, we economists should recognize the truth that, throughout a very

long period of its history, our science has been concerned with hypotheses while it has pretended to the discovery of laws.

Having defined our terms and illustrated our method, we pass to the consideration of economic theories of wages in the light of existing data relating to the income of laborers. The persistence in economic speculation of the doctrines of wages that are associated with the names, respectively, of Turgot and Ricardo requires that the statistical economist should measure, if he can, the degree of truth contained in each theory. Data are now available, perhaps for the first time, upon which to base an inductive investigation. This material is utilized to measure the degree of relation between wages and the cost of the means of subsistence, and between wages and the standard of life of the laborer.

The theory according to which, under perfect competition, the laborer tends to receive as wages the value of his specific product is one phase of a general theory of distribution that owes its development to contemporary economists. It will not be denied, I think, that one's attitude toward theoretical economics and industrial reform should be greatly affected by the outcome of an inductive test applied to this doctrine. The theory contains two principal parts: (1) as to the trend of the share of the product that goes to the whole class of laborers in the form of general wages, and (2) as to the law of the distribution of general wages among the subgroups form-

ing the laboring class. These two parts of the productivity theory of wages I have subjected to statistical treatment.

Owing to the fact that the productivity theory was developed by economists who employed the device of a static state to facilitate the working of their isolated hypotheses, it has been assumed by sympathetic critics that its validity is limited to a hypothetical static state. This criticism must be withdrawn if it can be shown that the theory supplies the clue to the explanation of a concrete, highly dynamic phenomenon of the first importance. What light can the productivity theory of wages throw upon the scientific problem of the economic laws of strikes and their outcome? To answer this question the first obvious desideratum is the proof that strikes and their outcome are subject to law; it will then be time to inquire whether the observed regularities are explicable by means of the productivity hypothesis.

Of at least equal importance with the question of the relation of strikes to wages is the consideration of the effects upon the condition of the laborers of the concentration of industry in large establishments. It will be shown, for example, that the mean rate of wages in the textile industries tends to increase with the size of the establishment. But what shall be the interpretation of this result? Shall the inference be that the more highly organized technical equipment of the larger establishments results in a

higher effective productivity of the laborer, which finds its expression in a larger wage? Or may it not be that the great industrial machines select the ablest laborers at the age when they are most productive, and then, after the very best of their lives has been exploited, throw them out of the industry to find their support elsewhere? The law of the variation of wages with age, in the general industry and in the large establishments, will give light upon this problem. The high mean wages of large establishments may be spurious averages due to the different ages of the populations in large and in small establishments. The real social gain or loss resulting from the concentration of industry can be measured only after the consequences have been apprehended of the selective process that concentration entails.

In a concluding chapter, the general results of the essay are summarized with the purpose of considering their bearing upon the problem of the organization of industry. It is hoped that, supported as they are by economic theory and inductive verification, they may, in their degree, add to the positive knowledge that shall be utilized in the control of the economic changes that follow upon our increasing wealth and population.

CHAPTER I

STATISTICAL LAWS

"En général, une théorie scientifique quelconque, imaginée pour relier un certain nombre de faits trouvés par l'observation, peut être assimilée à la courbe que l'on trace d'après une définition mathématique, en s'imposant la condition de la faire passer par un certain nombre de points donnés d'avance. Le jugement que la raison porte sur la valeur intrinsèque de cette théorie est un jugement probable, dont la probabilité tient d'une part à la simplicité de la formule théorique, d'autre part au nombre des faits ou des groupes de faits qu'elle relie." — COURNOT.

THE statistical economist is concerned with economic facts, hypotheses, and laws. He begins his investigations with the assembling of facts, and seeks through the mediation of hypotheses to arrive at laws. As economist, his aim is to throw the greatest possible light upon the relation of the economic facts before him, and, as scientist, he expects to achieve this end by summarizing the descriptions of the relations of facts in the simplest and most general formulæ possible. Equipped with new and powerful instruments of research, he approaches his task in a precise, systematic way that yields results in a much more definite and usable form than the inspiring generalizations of the early masters of the science.

What, precisely, was the meaning of Adam Smith in

his enumeration of the following circumstances in connection with the discussion of the inequalities in wages? "First, the agreeableness or disagreeableness of the employments themselves; secondly, the easiness and cheapness, or the difficulty and expense of learning them; thirdly, the constancy or inconstancy of employment in them; fourthly, the small or great trust which must be reposed in those who exercise them; and fifthly, the probability or improbability of success in them." Did he mean that these factors are always present as causes of inequalities in wages, that they are of equal importance, and that wages vary in either direct or inverse ratio with their several variations? Or, was not his meaning, rather, that the enumerated factors are so many possible hypotheses, one or more of which, in particular cases, may give the clue to the observed inequality in wages? Before it would be allowable to speak of a law of wages, in any particular case, it would be necessary to show not only that wages vary with the assumed factor, but to derive the formula of the variation and to measure the degree of association between the phenomena.

It will contribute to the better understanding of the nature of the results in subsequent chapters to consider here the meaning of the terms: general or representative fact, hypothesis, statistical law.

In the accompanying Figure 1 the details of a "scatter diagram"[1] are depicted. A scatter diagram is a graphic description of the quantitative relation

[1] A term due to Professor Pearson.

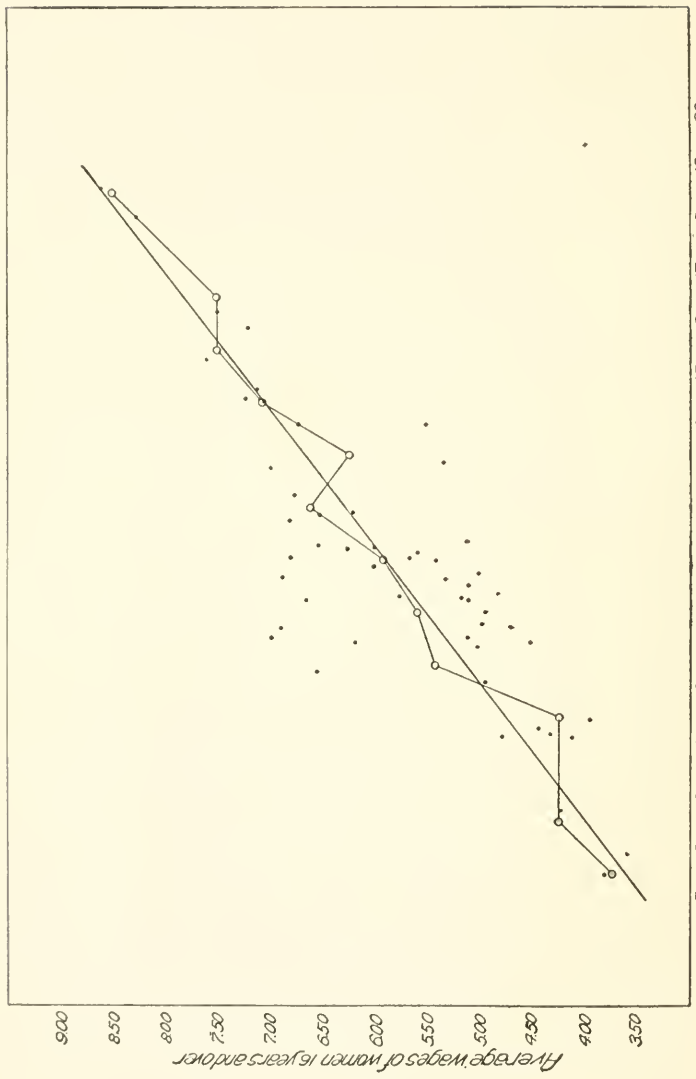

FIGURE 1. — A scatter diagram illustrating the relation between the wages of men and the wages of women in the states and territories of the United States.

TABLE I.—Correlation between the Average Wages of Men and the Average Wages of Women in the Several States and Territories of the United States

Average Wages of Women in Dollars per Week	Average Wages of Men in Dollars per Week														Totals
	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	
3.50 4.00	2			1											3
4.00 4.50		1		3											4
4.50 5.00				1	2	3									6
5.00 5.50					1.5	3	4.5		1						10
5.50 6.00						1	2								3
6.00 6.50					2		3	1							6
6.50 7.00						3	3	3		1					10
7.00 7.50									1	2	1	.5			4.5
7.50 8.00											1	.5			1.5
8.00 8.50														1	1
8.50 9.00														1	1
Totals	2	1		5	5.5	10	12.5	4	2	3	2	1		2	50
Means	3.75	4.25		4.25	5.13	5.60	5.93	6.62	6.25	7.08	7.50	7.50		8.50	

between two series of facts. In this particular case the two groups of facts are the average wages of men and the average wages of women, in the several states and territories of the United States.[1] The scatter diagram is constructed by measuring in sequence upon the horizontal line the tabular values, for the several states and territories, of the average wages of men, and then plotting perpendicularly to these values the corresponding average wages of women. Each pair of related values is represented by a point upon the diagram. For example, in case of Montana, the average wage of men was $18.60 a week, and the corresponding wage for women was $8.60. This relation is indicated by the extreme point in the upper right-hand corner of the diagram.

The next stage in the construction of the scatter diagram is represented by the series of small circles that are connected by a broken line. The facts upon which this part of the construction rests are given in Table I. The individual observations are not dealt with directly as they are indicated upon the diagram, but they are grouped into arrays the characteristics of which are summarized in averages and then represented upon the diagram by circles. For example, in the states in which the average wages of men were between $10 and $11 a week, the corresponding wages of women formed an array whose average value was $5.60. This representative value of the

[1] The data are taken from the *Census of Manufactures*, 1905, Bulletin 93, p. 36.

array is indicated by the circle placed above the point $10.50, at a distance from the horizontal line corresponding to $5.60 on the perpendicular scale. The circles are connected by a broken line.

Suppose, now, that the particular problem to be investigated is the relation between the wages of men and the wages of women. From the general sweep of the scatter diagram one would say that the two quantities are related. But what is the exact nature of the function descriptive of the relation, and what is the degree of association between the wages of men and the wages of women? The attempt to give definite answers to these questions will lead to a specific instance of the exact use of the terms: general fact, hypothesis, statistical law.

The series of points upon the scatter diagram is simply a graphical transcript of a double entry table recording the series of related measurements. But where the observations mount into hundreds and thousands, it would be extremely laborious to consider directly the more or less accidental position of each point, and still, in giving a summary description of the relation of two series of values — which is the object of the investigation — it is not allowable to neglect the singularity of any point. Each point must have a weight in the investigation that is proportional to its importance.

Now, in any investigation, the general, or representative, fact is that fact which for the purpose in hand conveys the maximum of information about the group

it represents. In the problem before us, the arithmetical averages[1] of the items in the several arrays are regarded as representative of their respective groups. By substituting representative observations for the individual observations, the number of points to be treated, in the case under consideration, is reduced from fifty to twelve.

What is the law of the association of the representative points? The answer to that question is dependent upon the finding of the simplest curve that will fit satisfactorily the given representative points. An hypothesis must be made as to the nature of the curve that will satisfy the imposed conditions of simplicity and excellence of fit, and the hypothesis must then be tested by the representative facts. Until this test has been applied, there is no ground of preference for any particular hypothesis over an infinite number of other possible suppositions as to the relation of the series of phenomena under observation.

Incidentally it may be observed that the ideas "simplicity" and "excellence of fit" do not admit of rigid general definition. According to the point of view, a given curve may be either simple or complex: its formula may, for example, have few constants and for that reason be regarded as simple, but the computation of the constants may involve the use of extremely intricate processes, which would more than offset the simplicity due to the small number of

[1] For certain classes of problems it might be desirable to use other forms of representative values, for example, the mode or median of arrays.

constants. A particular curve may be regarded as simple and appropriate to given conditions because of its consonance with *a priori* theory, or its simplicity may rest entirely upon the facility with which it lends itself to analytical treatment. Similar observations may be made with regard to the idea of excellence of fit.[1]

Returning to the problem of the quantitative relation between the wages of men and the wages of women, we inquire whether the straight line upon the scatter diagram or some other curve not appearing upon the chart is the law of the relation between the wages of men and the wages of women. The query leads to the definition of the term statistical law. The statistical law of the association of two series of facts is the hypothesis that satisfies best the imposed conditions of simplicity and excellence of fit to the representative facts. The straight line in the scatter diagram, the equation to which is $y = .3829\,x + 1.5204$, satisfies the Pearsonian test[2] of excellence of fit, and is therefore regarded as the statistical law of the association of the money wages of men and the money wages of women. It may be said definitely that on the average, in the case before us, a variation of one dollar in the wages of men is associated with a variation of about 38 cents in the wages of women.

[1] A more detailed discussion of these ideas is given in the article "The Statistical Complement of Pure Economics." *Quarterly Journal of Economics*, November, 1908.

[2] *Philosophical Magazine*, July, 1900, pp. 157–175. *Biometrika*, 1902, pp. 155–163.

What is the measure of the degree of association between the money wages of men and the money wages of women? The above formula, as we have observed, conveys the information that upon the average a variation of one dollar in the wages of men is associated with a variation of about 38 cents in the wages of women. But does a variation of 38 cents in the wages of women bear the same proportion to the total variation of the wages of women that a variation of one dollar in the wages of men bears to the total variation of the wages of men? In order that an abstract number expressing the measure of correlation between the two series of facts may be obtained, the associated variations must be expressed in terms of units that measure the respective variabilities of the two groups of facts.

The law of the associated variation is $y = .3829\,x + 1.5204$, where the origin of the coördinates is at zero. If the origin be transferred to the mean of the system of points, that is, to the point the coördinates of which are the mean of the wages of men and the mean of the wages of women, the equation becomes $y = .3829x$. If, now, the standard deviation of the wages of men be represented by σ_1, and the standard deviation of the wages of women, by σ_2, the equation may be written $y = r\frac{\sigma_2}{\sigma_1}x$, or $\frac{y}{\sigma_2} = r\frac{x}{\sigma_1}$, where r, which is the coefficient of correlation, measures the degree of association between the variation in the money wages of men and the money wages of

women, the variations being expressed in terms of the standard deviations of the respective groups. But, in the particular case before us,

$$r\frac{\sigma_2}{\sigma_1} = .3829 \text{ and } \sigma_1 = 2.6915,\ \sigma_2 = 1.1898.$$

Therefore $$r = \frac{2.6915}{1.1898}(.3829) = .866.$$

The coefficient of correlation varies between the limits ± 1. When $r = \pm 1$, the correlation between the associated variations of the phenomena is perfect. When $r = o$, there is no linear correlation. Intermediate values of r express the degrees of association between the series of phenomena.

Inasmuch as the coefficient of correlation, r, is an abstract number that is independent of the concrete units in which the phenomena are expressed, it makes possible the comparison of the degree of association between series of phenomena that are qualitatively different. For example, it may be proved that the wages of skilled laborers vary with the wages of unskilled laborers, and it may likewise be shown that the wages of skilled laborers vary with their standard of life. But in each case, what is the law of variation and what is the degree of association between the two variables? Are the wages of skilled laborers more closely connected with the wages of unskilled laborers than with their own standard of life? The appropriate coefficients of correlation give the answers to these questions, as we shall see, in the next chapter.

We have now a very concrete and definite idea of representative, general facts, hypotheses, and statistical laws. By a progressive synthesis a statistical investigation passes from individual observations to representative facts and from representative facts to statistical laws. The representative facts exhibit the characteristics of the individual observations which, for the purpose in hand, are most useful. The statistical law summarizes in the simplest possible formula the information conveyed by the representative facts.

The meanings of these terms in the theory of statistics have a general resemblance to their usage in the other sciences. For, a theory or hypothesis as to the association of given facts, in any department of knowledge, may be likened to an hypothesis as to the simplest form of curve that will pass as nearly as possible to given points. In each case the individual observations — the facts and the points — fall into groups that may be described by typical, representative facts. The hypothesis or theory in each case is the supposition as to the nature of the relation of the representative facts. The law of the facts and of the points is the supposition that satisfies best the accepted standard of simplicity and excellence of fit of the facts to the hypothesis. Before any theory is accepted as the appropriate explanation of the phenomena, proof must be submitted that the facts which it purports to describe are representative facts and that it satisfies the approved

test of simplicity and excellence of fit to the general facts.

But added to the common idea in the general use of these terms, there are special characteristics in case of statistical laws that must be discriminated. The inductive laws that are established by means of statistical methods in the social sciences are —

(1) Laws of mass phenomena.

In order to arrive at the conception of statistical law that has been described in this chapter, we summarized the characteristics of groups of phenomena by means of representative facts, and then proceeded to test the hypothesis as to the relation of the general facts by means of a conventional standard of simplicity and excellence of fit. As the test is applied with reference to the general facts, the law is, in reality, the law of the general facts: its validity is limited to the general facts and need not apply to the particular instances. For example, a knowledge of the law of mortality will not enable one to predict that X. aged forty years, will die in a given year. The law, however, does yield the necessary information for predicting the average proportion of those now living who will die in successive years.

(2) Laws the strict validity of which is limited to a particular time and place.

A statistical social law is a summary description of the resultant of many independent factors whose combination varies in time and place. The statistical law of the variations of price with the supply of a commodity has one form in a highly competitive center and quite a different form in an agricultural community.

(3) Laws the strict validity of which does not extend beyond the limits of observation.

A statistical law of inheritance derived from the investigation of a population varying between the normal limits should not be assumed to apply to dwarfs and giants.

(4) Laws the generality of which ranges from an empirical summary of the quantitative relation between series of facts of a particular time and place to an inductive verification of a general theorem of *a priori* science.

It would be easy to establish that, in a particular country, at a given time, the average wage of laborers varies in direct relation with the density of the population. But such a law of association is simply an empirical law. If we extended our investigation to different times and places, we should expect to find a great variation in the degrees of association of the two phenomena. But suppose that the productivity theory of wages should receive inductive verification

in a particular instance. In that case the confidence in the generality and the stability of the results would be far greater because of the added weight of the *a priori* demonstration.

It has been frequently assumed, even by economists, that pure economics, concerned as it is with general theories, can have but scant relation to the varying succession of particular instances of concrete life. And, indeed, it is sometimes regarded as futile to attempt to bring the two into factual relation. But there can be little doubt that the despairing note is due to our ignorance of the empirical laws that bind together the whole social organism. A definite conception of the character and strength of these binding ties must lead to a perception of the direct connection between pure theory and concrete life.

Statistical economics, in which the following chapters are essays, proposes this twofold object: (1) to bring to the test of representative facts the hypotheses and theorems of pure economics; (2) to supply data, in the form of general facts and empirical laws, for the elaboration of dynamic economics.

CHAPTER II

WAGES, MEANS OF SUBSISTENCE AND THE STANDARD OF LIFE

"The natural price of labour, therefore, depends on the price of the food, necessaries, and conveniences required for the support of the labourer and his family." "It is not to be understood that the natural price of labour, estimated even in food and necessaries, is absolutely fixed and constant. It varies at different times in the same country, and very materially differs in different countries."

— RICARDO.

THREE aspects of the remuneration of labor have each, at different times, so engaged the attention of economists as to lead to three different theories of wages: the theory of the dependence of wages upon the means of subsistence; the theory of their dependence upon the standard of life; and the theory of their dependence upon the laborer's economic productivity. The special conditions of the times in which these hypotheses had their origin were doubtless responsible for the distorted perspective exhibited in the various attempts to state a scientific theory of the laborer's income. In recent years there has been a disposition to recognize that each of the partial sketches contains an element of truth, but the degree of truth in each has not been measured, and consequently it has not been possible to weave into a satisfactory whole the elements supplied by the several theories.

"The general tendency of wages since the introduction of power machinery and the employment of women and children in its operation has been upward, but it will be difficult to decide positively whether such increase is due absolutely to the use of machinery or to a higher standard of living, or to the increased productivity of labor supplemented by machinery, or to all these causes combined, or to other causes. . . . This phase of the subject therefore involves too much speculation for a thoroughly statistical presentation; the method can be only suggestive of the arguments which might be used for or against the use of machinery because of its effect on wages."[1]

To accept this view of the problem of wages and of the limitations of the statistical method would be to abandon the hope of solving one of the most important problems of industrial life. Indeed, if the power of the statistical calculus does not suffice to analyze this problem into its constituent elements, then all effort in the direction of a concrete science of economics is vain; for all the fundamental problems of the science present similar degrees of complexity.

Instead of seeking a unique solution of the wages question in an *a priori* way, we shall approach the concrete problem by attempting to find statistical answers to several important questions related to

[1] *Thirteenth Annual Report of the Commissioner of Labor, for the United States*, 1898, Vol. 1, p. 5.

the subject of this chapter. In the following chapters other aspects of the problem will be investigated.

Do wages vary with the cost of the means of subsistence, and, if so, what is the law of the variation and what is the measure of the correlation in the variation? Do wages vary with the standard of life, and, if so, what is the law of the variation and the degree of the correlation? Are wages more directly affected by the cost of the means of subsistence than by the standard of life? Do the answers to these questions differ according as the wages of skilled or of unskilled labor are under investigation? Is there any relation between the variation of the wages of skilled labor and the wages of unskilled labor? If there is such a relation, how does the degree of correlation compare with the correlation of wages with the cost of the means of subsistence and with the standard of life? These are some of the very critical questions affecting the theory of wages that need to be treated in an inductive way.

Description of Data.

Table I, in the Appendix to this chapter, embodies a valuable collection of material relating to the means of subsistence, the standard of life and wages. It is drawn from the monumental report on *Salaires et durée du travail dans l'industrie française* which was published, in 1893–1897, by the French *Office du Travail*. It has the advantage of having been col-

lected and compiled by a single authority and of covering 87 separate *départements*, thus insuring, through the method and simultaneity of the collection of data, an unusual comparability of results, and, through the scope of the investigation, an adequacy of material for scientific generalization.

In column I, the 87 *départements* of France are enumerated. In columns II and III, the mean wages respectively of unskilled and of skilled laborers are given. The raw material upon which the means are based was obtained from the *conseils de prud'hommes*, in 1896. The means given for *manœuvres*, or unskilled laborers, are derived from the wages of *journaliers* and *terrassiers*, and the means for skilled laborers (*l'ouvrier de métier ordinaire*) are the averages for the following trades: *compositeur d'imprimerie, cordonnier, tailleurs d'habits, charron, maréchal ferrant, plombier, maçon.*[1]

In column IV is tabulated for each *département* a "*coefficient de dépense en objets d'alimentation et de chauffage*," which will be referred to, in the argument later on, as the cost of the means of subsistence. The figure given, in case of each *département*, represents the cost in that *département* of definite quantities of selected commodities that are regarded as sufficient to sustain, for one year, a family of six members three of whom, on the average, are at work. The prices that enter into the estimate of the costs are wholesale prices that were paid in the respective *départements*, in

[1] *Salaires et durée du travail dans l'industrie française*, Vol. IV, pp. 225, 239, 240.

1893, by representative institutions, such as schools and hospitals. The kinds of commodities making up the laborer's budget were selected by the *Office du Travail* after having examined the series of index numbers previously used in other investigations in France. An actual record of expenditures by 14 families of weavers, composed of six members three of whom, on the average, were at work, formed the basis for the estimate as to the portions in which the several commodities should enter into the index number. It is to these weaver budgets that reference is made in the French report as to the principles that were followed in composing the standard: "*nous prendrons simplement pour base de la dépense, en objets d'alimentation, des quantités exprimées en chiffres ronds, de telle manière:* (1) *que ces quantités soient effectivement capables d'assurer l'existence de 6 personnes, par exemple*; (2) *que la répartition de la dépense qui en résulte ne s'écarte pas trop de celle rapportée ci-dessus.*" [1]

The figures in column IV represent, therefore, the relative costs in the several *départements* of fixed means of subsistence.[2]

[1] *Salaires et durée du travail dans l'industrie française*, Vol. IV, p. 251.

[2] The kinds and quantities of the commodities are tabulated in Vol. IV, p. 252.

In criticism of this standard budget, it may, of course, be objected that retail, instead of wholesale, prices should have been used. But the *Office du Travail* resorted to the use of wholesale figures only after the failure of the attempt to secure satisfactory retail prices. Besides, the wholesale figures were regarded by the *Office du Travail* as being fairly representative of the local variations of retail prices in France.

It is to be regretted that an error of unknown magnitude was introduced in the effort to compensate for the relatively low wholesale

Column V contains for each *département*, the daily "*prix ordinaire de pension payé par l'ouvrier isolé pour le logement et la nourriture.*" In the subsequent argument, this column will be referred to as being representative of the cost of the standard of life.[1] Column V differs from column IV in that the *prix de pension* is representative of a standard that varies in kind and quantity, as well as in prices, from *département* to *département*, while column IV simply records the departmental prices of a fixed mode of subsistence. The figures were obtained, in 1896, from the *conseils de prud'hommes*.[2]

With this description of our data, we may now enter upon an investigation of the interdependence of the several factors that have been described.

Wages and the Means of Subsistence.

In its crassest form the doctrine that wages are determined by the means of subsistence of the laborer was formulated by Turgot. "*En tout genre de travail*

prices by increasing the quantities of commodities. "*Comme les prix qui servent de base aux calculs ci-après sont des prix de gros, nous avons à dessein plutôt forcé les quantités à multiplier par ces prix, de telle façon que les produits représentent, aussi approximativement que possible, la dépense ordinaire d'une famille ouvrière, du type observé, qui achète au détail les objets nécessaires à l'alimentation et au chauffage.*"—Vol. IV, pp. 252–253.

[1] I think I am aware of the criticisms that may be urged against the assumption that the varying *prix de pension* is representative of the varying standard of life. My study is intended as a first approximation, and I hope that judgment will be suspended until the argument of the chapter is completed.

[2] *Ibid.*, Vol. IV, pp. 244–245, 257–258.

il doit arriver et il arrive en effet que le salaire de l'ouvrier se borne à ce qui lui est nécessaire pour lui procurer sa subsistance."[1]

If this doctrine has any relevancy to the conditions of France to-day, one would say, *a priori*, that the wages of unskilled laborers must be in close association with the cost of the means of subsistence. If the relation between the two is one of cause and effect, that is to say, if the wages of unskilled laborers are determined by the means of subsistence, then the degree of association must approach unity. These corollaries of the Turgot doctrine may be tested by means of columns II and IV of Table I.

Turgot's doctrine relates to real wages. Column IV, as we have seen, is the cost in the different *départements* of a fixed mode of life that approaches the necessary means of subsistence of a laborer's family. If the relation between means of subsistence and the wages of unskilled laborers is a relation of cause and effect, then the money wages of unskilled laborers in the several *départements* should be closely correlated with the corresponding prices of the means of subsistence in the *départements*.

How close is the association actually found to be? The graph showing the relation between the variation in the cost of subsistence and the wages of unskilled laborers is given in Figure 2. The law of the associated variation of wages with the cost of subsistence is the equation to the straight line, namely, $y = .864$

[1] Turgot: *Réflexions sur la formation et la distribution des richesses.*

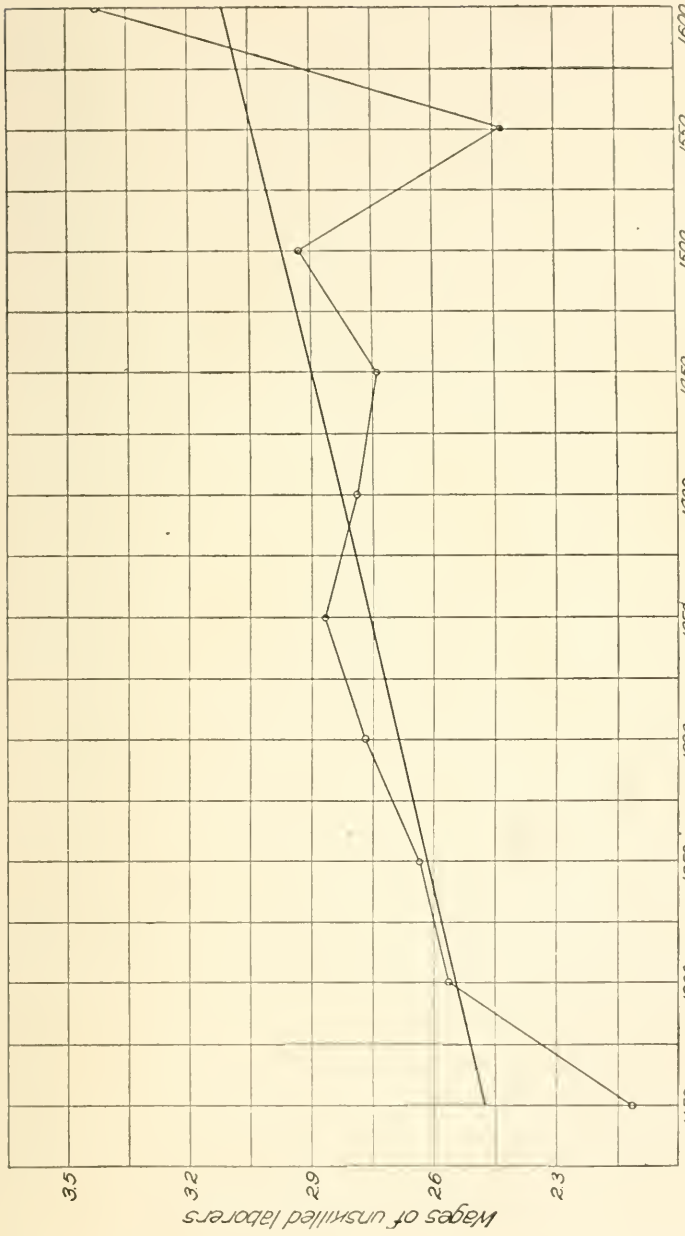

FIGURE 2.—Illustrating the relation between the wages of unskilled laborers and the index number of prices of food and fuel.

$+.0014\,x$. The coefficient of correlation is $r = .306$. If we agree to regard values of r less than .25 as indicating low correlation; between $.25 - .50$, as fair correlation; $.50 - .75$, as high correlation; and $.75 - 1.00$, as very high correlation, then, we may say that the correlation between the wages of unskilled laborers and the means of subsistence, as tested by the official data for France, is only fair. We do not overlook the facts that the computation of column IV presented very great difficulties, and that if rent, properly estimated, had been included and the remaining figures had been more accurately determined, a closer relation might have been discovered.

The hypothesis of the causal relation between the means of subsistence and the wages of unskilled laborers may be tested. If the relation between the two were a relation of cause and effect, then r should approach unity.[1] It is found, however, that the actual value of r is $.306 \pm .066$. When the probable error of r is considered, it is seen that, if the means of subsistence and the wages of unskilled laborers were in causal relation, such a deviation of r from unity as .306 would be practically impossible.

So far as the data under investigation represent the conditions of France to-day, it may be said —

(1) that the wages of unskilled laborers vary in the same direction as the cost of the means of subsistence;

[1] Pearson: *Grammar of Science*, 2d edit., p. 397.

(2) that the law of the association of the wages of unskilled laborers and the means of subsistence is linear;

(3) that the value of the coefficient of correlation is $r = .306. \pm .066.$

(4) that there is no relation of cause and effect between the two.

These conclusions are based upon the data for all of the 87 *départements* of France, excepting the *Seine* and *Rhin (Haut)*. For the latter, no record is available in case of column IV. The *Seine*, being the *département* of Paris, presents anomalous conditions.

Wages and the Standard of Life.

Despite Lassalle's intrepretation of Ricardo, the classic theory of the relation of wages to the standard of life is found in Ricardo's chapter, "On Wages."

"The natural price of labour . . . depends on the price of the food, necessaries and conveniences required for the support of the labourer and his family." "It is not to be understood that the natural price of labour, estimated even in food and necessaries, is absolutely constant. It varies at different times in the same country and very materially differs in different countries."[1]

The thesis is that the standard of life varies in time and in place and that the wages of laborers vary *pari passu*. The phases of the doctrine relating to local variations will be subjected to a test.

[1] Ricardo: *Principles of Political Economy and Taxation*. McCulloch's edition, pp. 50, 52.

Do the wages of unskilled laborers in France vary with the local variations in the standard of life? If a concomitant variation does exist, what is the measure of the degree of association between the variables? An approximate answer to these questions may be obtained from the data of Table I. In column II of that Table are recorded the average wages of unskilled laborers in the several *départements*. In column V, the local values are tabulated of our representative of the standard of life — the *prix ordinaire de pension payé par l'ouvrier isolé pour le logement et la nourriture.*

From these data we find —

(1) that the money wages of unskilled laborers vary in the same direction as the cost of the standard of life;

(2) that the law of the association of the money wages of unskilled laborers and the cost of the standard of life is linear;

(3) that the money wages of unskilled laborers are much more closely related to the cost of the standard of life than to the cost of the means of subsistence. In the former case $r = .667$; in the latter, $r = .306$.

The graph representing the relation of the two variables is given in Figure 3. In making the computations, all of the *départements* for which records exist were considered except *Gironde* and *Maine-et-Loire.*

Figure 3 exhibits the law of the variation of wages

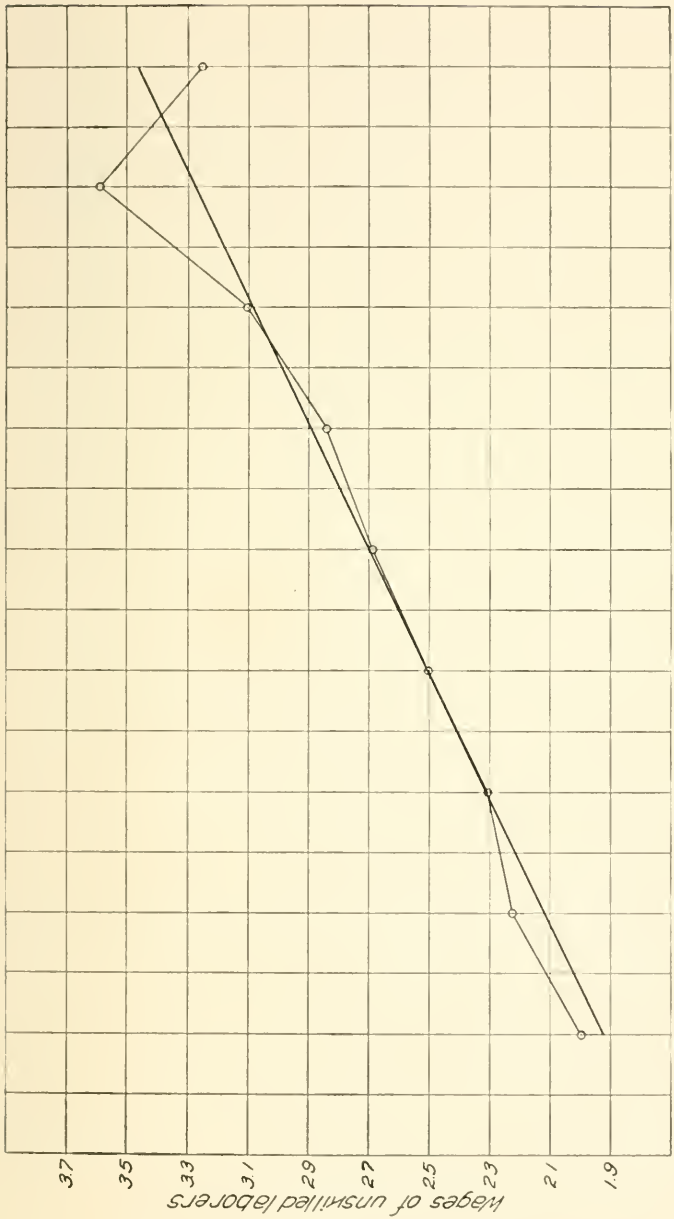

FIGURE 3. — Illustrating the relation between the wages of unskilled laborers and their standard of life.

of unskilled laborers as the *prix de pension* varies from *département* to *département*. If the *prix de pension* were taken as a function of the wages of unskilled laborers we should have, as the equation of the relation between the two variables, $y = .5786\ x + .2537$, where x is put for the wages of unskilled laborers. From this equation it is clear that, for an increase of one franc in the wages of unskilled laborers, there is on the average an increase of about 58 centimes in the *prix de pension*.

There is a subtle difficulty to be overcome before our investigation can be brought into closer relation with the Ricardian doctrine. The preceding results are conclusions as to the relation between money wages and the *prix de pension*. But the Ricardian doctrine, postulating an invariable money unit, is a theory as to the relation of wages and the concrete things composing the standard of life. Would it be possible to close the gap between our results and the Ricardian theory ?

The statistical calculus supplies the tool for connecting the empirical conclusions with the *a priori* doctrine. Thus far it has been shown that the money wages of unskilled laborers are correlated with the *prix de pension* and also with the *coefficient de dépense en objets d'alimentation et de chauffage*. Let us represent the coefficient measuring the correlation in the first case by r_{12}, and in the second case by r_{13}. The *coefficient de dépense*, we know, is the money value of the same kinds and quantities of things in the different *dé-*

partements, while the *prix de pension* is the price of a standard that varies from *département* to *département*. As the former represents the variation in the purchasing power of money in the different regions of France, we should infer that the *prix de pension* would be correlated with the *coefficient de dépense*. Let the measure of correlation in this case be r_{23}. In order to connect our results with the Ricardian theory it is necessary to eliminate from the empirical conclusion as to the relation of the money wages of unskilled laborers to the price of the standard of life the factor due to the local variation in the purchasing power of money.

According to the theory of the partial coefficient of correlation,[1] if three variables are so interrelated that their gross coefficients of association are respectively r_{12}, r_{13}, r_{23}, then the partial or net coefficient of correlation between the variables 1 and 2 is measured by $\rho_{12} = \frac{r_{12} - r_{13}r_{23}}{\sqrt{1 - r_{13}^2}\sqrt{1 - r_{23}^2}}$. Using this method of treating our problem, we find that the net correlation between the wages of unskilled laborers and their standard of life is $\rho_{12} = .628$, where the r symbols in the above formula for ρ_{12} have the meanings described in the preceding paragraph. The actual values of these coefficients are $r_{12} = .6667$ (the coefficient of correlation between money wages of unskilled laborers and the *prix de pension*); $r_{13} = .3064$

[1] See G. Udny Yule: "On The Theory of Correlation." *Journal of the Royal Statistical Society*, December, 1897.

(the coefficient of correlation between the money wages of unskilled laborers and the *coefficient de dépense en objets d'alimentation et de chauffage*); $r_{23} = .3405$ (the coefficient of correlation between the *prix de pension* and the *coefficient de dépense en objets d'alimentation et de chauffage*).[1]

From this result it follows that, so far as the data upon which the investigation rests may be assumed to be representative of the true values of the factors in the problem, the degree of association between the wages of unskilled laborers and their standard of life[2] is measured by $\rho_{12} = .628$.

[1] In computing the value of r_{23}, all of the records were used except that for Lozère.

[2] I have been unable to find in the French report any precise definition of the term *l'ouvrier isolé* as it appears in the investigation concerning *prix de pension payé par l'ouvrier isolé pour le logement et la nourriture*. Does it refer to the single unskilled laborer, or to the single skilled laborer, or was it impossible to measure the difference between the *prix de pension* of the two classes of laborers? The last interpretation would seem most probable; for the attempt, in Vol. IV, p. 260, to compare the wages of skilled and of unskilled laborers with the *prix de pension payé par l'ouvrier isolé* assumes a common *prix de pension* for the two classes of laborers.

It may be noted incidentally that the present chapter contains a solution of the problem that is abandoned in the French report. "*A vrai dire, la relation qui peut exister entre le salaire et la dépense pour le logement et la nourriture ne semble ni directe, ni simple.*" — p. 260. The relation is both direct and simple and the coefficient measuring the degree of the net relation is $\rho = .628$.

The justness of taking the *prix de pension* as the representative of the standard of life of unskilled laborers is reënforced by the consideration that the mean value of the *prix de pension d'un ouvrier isolé* is 76 per cent of the mean value of the wages of unskilled laborers. It therefore represents with a high degree of accuracy the effort of the unskilled laborer to maintain a standard that varies from *département* to *département*.

Wages of Skilled and of Unskilled Laborers.

Table I supplies data for measuring a relation that has great importance for the theory of Chapter IV, and for the appreciation of practical schemes that have for their aim the raising of the level of general wages. What is the relation between the variation in the wages of skilled and of unskilled laborers? The results that are about to be given are based upon a consideration of all of the 87 *départements* of France, except three, — *Seine*, *Seine-et-Marne*, *Seine-et-Oise*, which are unduly affected by the peculiar conditions of wage receiving in Paris.

We find —

(1) that the wages of skilled and of unskilled laborers vary in the same direction;
(2) that the law of the relation is linear;
(3) that the coefficient of correlation is $r = .775$, which is higher than the coefficient measuring the correlation between the wages of unskilled laborers and the cost of the standard of life.

The graph representing the relation is given in the accompanying Figure 4. The equation to the straight line is $y = 1.24 + .9142\,x$, where $x =$ the wages of unskilled laborers.

Inasmuch as both classes of wages are affected by the local variations in the purchasing power of money, the net relation between the two variables

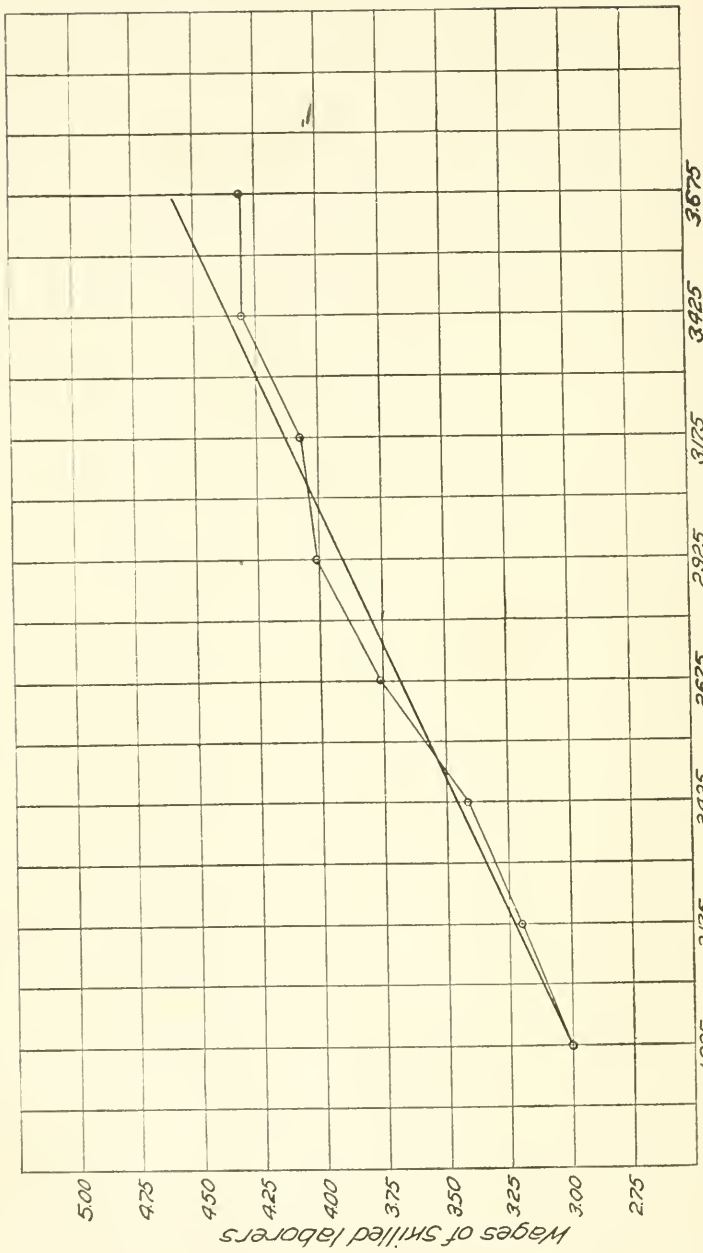

FIGURE 4.—Illustrating the relation between the wages of skilled laborers and the wages of unskilled laborers.

can be found only after the money factor is eliminated. If, as in a previous case, we represent the correlation between the wages of skilled laborers and the wages of unskilled laborers by r_{12}; the correlation between the wages of skilled laborers and the *coefficient de dépense en objets d'alimentation et de chauffage* by r_{13}; and the correlation between the wages of unskilled laborers and the *coefficient de dépense* by r_{23}; then, the net correlation between the wages of skilled laborers and the wages of unskilled laborers is $\rho_{12} = .757$.

We have now definite quantitative solutions to the problems we set out to examine. The wages of unskilled laborers vary, from place to place in the same country, directly (1) with the cost of the means of subsistence, (2) with the standard of life, the closeness of the relation being measured, respectively, by $r = .306$, $\rho = .628$. The wages of skilled laborers vary directly with the wages of unskilled laborers, the degree of the association being measured by $\rho = .757$.

The very high correlation between the wages of skilled laborers and the wages of unskilled laborers suggests the wisdom of further investigation as to the mechanism of their relation. This investigation is supplied in Chapter IV, on "Wages and Ability."

APPENDIX

TABLE I. — Data as to Wages, Means of Subsistence and Cost of Living in France

	I	II	III	IV	V		I	II	III	IV	V
	Départements	Salaire par 10 Heures de Travail du Manœuvre	Salaire par 10 Heures de Travail de l'Ouvrier de Métier Ordinaire	Coefficients de Dépense en Objets d'Alimentation et de Chauffage	Prix Ordinaire de Pension Payé par l'Ouvrier Isolé pour le Logement et la Nourriture		Départements	Salaire par 10 Heures de Travail du Manœuvre	Salaire par 10 Heures de Travail de l'Ouvrier de Métier Ordinaire	Coefficients de Dépense en Objets d'Alimentation et de Chauffage	Prix Ordinaire de Pension Payé par l'Ouvrier Isolé pour le Logement et la Nourriture
1	Ain	2.75	3.15	1349	2.25	45	Loiret	3.40	4.00	1284	——
2	Aisne	2.90	4.00	1280	2.50	46	Lot	2.25	3.00	1265	1.45
3	Allier	2.50	3.50	1210	2.25	47	Lot-et-Garonne	2.50	3.15	1414	2.35
4	Alpes (Basses)	2.75	3.50	1387	——	48	Lozère	2.35	3.00	1528	1.35
5	Alpes (Hautes)	2.75	3.25	1213	2.65	49	Maine-et-Loire	2.85	3.85	1320	3.50
6	Alpes-Maritimes	3.50	4.25	1609	2.50	50	Manche	2.75	4.00	1287	2.00
7	Ardèche	2.30	3.25	1297	1.65	51	Marne	3.30	4.50	1286	2.30
8	Ardenne	3.15	4.00	1203	2.00	52	Marne (Haute)	2.90	4.00	1231	2.80
9	Ariège	2.25	3.50	1218	——	53	Mayenne	2.05	3.00	1452	1.50
10	Aube	3.10	4.00	1344	2.65	54	Meurthe-et-Moselle	2.75	4.25	1267	1.50
11	Aude	2.75	4.00	1381	——	55	Meuse	3.05	3.35	1253	2.25
12	Aveyron	2.50	3.50	1188	1.65	56	Morbihan	2.25	3.25	1173	1.40
13	Bouches-du-Rhône	3.25	4.55	1374	——	57	Nièvre	2.50	3.80	1334	2.00
14	Calvados	3.00	3.75	1314	3.00	58	Nord	3.15	3.85	1236	1.85

15	Cantal	2.50	2.75	1272	1.60	59	Oise	3.00	4.50	1412	2.35
16	Charente	2.50	4.00	1255	2.15	60	Orne	2.50	3.15	1321	2.15
17	Charente-Inférieure	3.15	4.00	1280	2.45	61	Pas-de-Calais	2.75	3.40	1296	2.25
18	Cher	2.45	3.90	1198	2.00	62	Puy-de-Dôme	2.60	3.50	1298	2.15
19	Corrèze	2.25	3.35	1413	——	63	Pyrénées (Basses)	2.10	3.00	1327	2.10
20	Corse	2.25	3.50	1511	1.15	64	Pyrénées (Hautes)	2.35	3.00	1283	1.75
21	Côte-d'Or	3.40	4.50	1327	2.25	65	Pyrénées-Orientales	2.50	4.00	1457	——
22	Côte-du-Nord	2.00	2.85	1149	1.00	66	Rhin (Haut). Belfort	2.75	4.00	——	2.25
23	Creuse	2.25	3.35	1226	1.50	67	Rhône	3.40	4.50	1335	2.35
24	Dordogne	2.25	3.00	1239	1.85	68	Saône (Haute)	2.65	3.85	1284	2.50
25	Doubs	2.85	4.10	1281	2.35	69	Saône-et-Loire	2.75	3.55	1300	2.35
26	Drôme	2.75	4.00	1347	2.35	70	Sarthe	2.75	3.65	1223	——
27	Eure	3.00	4.20	1295	2.35	71	Savoie	3.00	4.00	1192	2.00
28	Eure-et-Loir	3.25	3.75	1472	2.00	72	Savoie (Haute)	3.00	4.00	1258	1.75
29	Finistère	1.85	3.00	1145	1.15	73	Seine	5.00	7.50	1501	2.85
30	Gard	3.00	4.50	1436	2.35	74	Seine-Inférieure	3.35	4.50	1215	2.50
31	Garonne (Haute)	2.60	3.90	1323	1.85	75	Seine-et-Marne	3.25	4.85	1383	3.00
32	Gers	1.85	3.25	1296	1.70	76	Seine-et-Oise	3.60	6.10	1476	3.00
33	Gironde	3.75	4.50	1382	3.75	77	Sèvres (Deux)	2.50	3.35	1168	2.35
34	Hérault	3.55	4.00	1379	2.40	78	Somme	2.60	3.35	1241	2.15
35	Ille-et-Vilaine	2.35	3.10	1133	2.00	79	Tarn	2.40	3.10	1218	1.70
36	Indre	2.25	3.50	1223	2.00	80	Tarn-et-Garonne	2.00	3.10	1381	1.65
37	Indre-et-Loire	3.30	4.35	1331	2.50	81	Var	2.85	4.15	1174	2.30
38	Isère	2.90	4.00	1489	2.00	82	Vaucluse	2.80	3.70	1285	1.85
39	Jura	3.00	3.75	1456	2.00	83	Vendée	2.75	4.05	1243	1.50
40	Landes	2.25	3.00	1278	1.50	84	Vienne	2.50	3.60	1235	——
41	Loir-et-Cher	2.75	3.85	1411	2.50	85	Vienne (Haute)	2.50	3.50	1272	——
42	Loire	3.15	4.00	1277	2.60	86	Vosges	2.50	4.00	1258	1.70
43	Loire (Haute)	2.50	3.00	1299	2.00	87	Yonne	2.75	4.60	1221	2.00
44	Loire-Inférieure	3.25	4.50	1303	2.00						

CHAPTER III

WAGES AND THE PRODUCTIVITY OF LABOR

"However wages may be adjusted by bargains freely made by individual men, the rates of pay that result from such transactions tend . . . to equal that part of the product of industry which is traceable to the labor itself."

"We must ascertain whether evolution makes labor more productive, and therefore better paid, or less productive and therefore worse paid."

—JOHN BATES CLARK.

A COMPLETE theory of wages faces two fundamental inquiries: (1) as to the law and cause of the variation in the share of the product of industry constituting general wages; and (2) as to the law and cause of the distribution of general wages among the members of the labor group. According to the productivity theory of wages, the principle of the specific productivity of labor supplies the clew to the satisfactory solution of both inquiries. It is the purpose of the present chapter to treat statistically certain phases of the first part of this theory, which is concerned with the determination of the rate of general wages. In the following chapter the second part will receive its proper attention.

We shall approach the very kernel of the productivity theory by successive stages. Three essential propositions in the theory will be established. It

will be demonstrated first that in a particular industry in which labor plays a relatively large rôle in production, the fluctuation in the rate of general wages varies directly with the fluctuation in the value of the product per laborer. It will then be established that the fluctuation in the laborer's relative share in the value of the product varies directly with the fluctuation in the amount of machine-power per laborer employed in the industry. In the third place, a proof in a particular instance will be supplied of an important dynamic corollary of the productivity theory of wages, namely, that, other conditions remaining the same, the general trend of the laborer's share of the product is determined by the ratio in which capital and labor are combined in production. These three investigations will bring to a statistical test the essential propositions in the productivity theory: the rate of general wages will be related to the productivity of labor, and the secular trend of the laborer's share in distribution will be brought into functional dependence upon the ratios in which capital and labor coöperate in production.

Description of Data.

The data forming the basis of the investigation are drawn from the history of coal mining in France. It is highly desirable that all three of the propositions which have just been described should be investigated with reference to the same industry, and it is necessary, if the statistical inductions are to

have value, that the investigation should extend over a great number of years. These desiderata obviously impose unusual statistical conditions in the selection of material; for they require that the statistical record shall cover many items that are difficult to ascertain and shall, in addition, be relatively uniform over a long period in its method of tabulation. There is only one[1] industry in France for which the required material is supplied, and I am not aware of the existence in any other country of data comparable in fullness of detail and in length of time over which the record is available. The figures upon which the investigation rests, and which appear in the three tables at the end of this chapter, have been taken from the careful work by M. François Simiand[2] on *Le Salaire des ouvriers des mines de charbon en France.*

Fluctuations in the Rate of Wages and in the Value of the Product.

The first proposition to be established is that, in an industry in which labor plays the leading rôle in production, the fluctuation in the daily rate of gen-

[1] "La seule industrie dont en France on connaisse chaque année par une publication officielle le nombre des ouvriers, leur salaire moyen journalier et leur gain annuel, la production et le prix de vente, est celle des mines de houille." — Levasseur: *Salariat et Salaires*, p. 31.

[2] M. Simiand has dealt in his own manner with the first proposition developed in this chapter. His acute study also contains a valuable section on the relation of the use of machinery to the rate of wages. I am greatly indebted to M. Simiand for the data that I have taken from his masterly treatise, but I have not borrowed from him either method or ideas.

eral wages varies directly with the fluctuation in the value of the daily product per laborer. The proposition is taken in this form simply as a first approximation to the theoretical principle that the rate of wages varies directly with the marginal productivity of labor.

It is quite a difficult task to ascertain directly the statistical equivalent of the marginal productivity of labor, and, of course, no record exists of the variation of the marginal productivity throughout a term of years. Fortunately for the inductive proof of this important principle, it is not necessary to treat the theory in the form of the marginal statement. The way out of the difficulty has been supplied by the analysis of Professor Clark.

In its cruder form, as it was first enunciated in principle by Von Thünen, the marginal[1] productivity theory of wages implied that at a given time the marginal laborer — who for the sake of simplicity was assumed to be the laborer most recently set at work — produced less than the laborers who were employed earlier, and that the advent of the marginal man not only reduced the amount that could be claimed by all the laborers, but was the occasion for diverting a part of the product of the earlier laborers to capitalists and entrepreneurs. It was one of the many services of Professor Clark to show that the specific product of every unit of labor is equal to the

[1] It is not meant to suggest that Von Thünen used the words "marginal productivity."

product of the marginal unit, that, at any given time, all units are alike in their productivity, that the fall in the productivity of labor occasioned by the advent of a new worker is due to a reapportionment of capital which gives to each laborer a smaller amount of capital as coöperating adjunct, and that the productivity of general labor is equal to the sum of the productivity of its constituent items. In view of this analysis, it follows that if an industry could be discovered in which labor played the chief rôle in production, the variations in the mean value of the product per laborer per day would be a close first approximation to the variations in the specific productivity of labor.

Table I, in the Appendix to this chapter, has been compiled as follows: Column II, giving the mean daily rate of wages, is derived from two items, (1) the total amount paid annually in wages, and (2) the number of days' work during the year. This second item is equal to the sum of the products of the number of laborers employed for various intervals of the year by the number of days during which they were respectively employed. Item (1) divided by item (2) gives the mean daily rate of wages tabulated in column II.[1] Column III is likewise derived from two items, (1) the value of the total annual product at the place of production, (2) the number of days' work during the year. The second item is the

[1] Simiand: *Le Salaire des ouvriers des mines de charbon en France*, pp. 24–25.

same as the second item in the preceding case. The figures tabulated in column III, giving the mean value of the daily product per laborer, are the ratios, for successive years, of the value of the annual product divided by the aggregate number of days' work per year.[1] Columns II and III, which record the simultaneous variations of the two factors for a period of fifty-six years, afford an ample basis for investigating the relation between the mean daily rate of wages and the mean value of the daily product per laborer. It should be remembered that, in case of the French coal miners, no formal sliding scale system by which wages varied with the value of the product existed during the period covered by this study.[2]

On Figure 5 is traced, for a period of fifty-six years, the history of the variation of the mean daily wages and of the mean value of the daily product per laborer. In each case the history of the change is recorded in an ascending zigzag line, which is the resultant of the forces determining its mean direction and the forces producing the vicissitudes portrayed in the fluctuations about the line of general trend. The proposition with which we are at present concerned is that, at a given time, the variation in the productiv-

[1] Simiand: *Le Salaire des ouvriers des mines de charbon en France*, p. 98.

[2] "Sans doute, nous savons qu'en fait le système dit de *l'échelle mobile*, qui fait varier le salaire suivant une certaine relation, en raison des variations du prix du produit dans le sens de la baisse aussi bien que dans le sens de la hausse, n'a jamais été adopté par les ouvriers et patrons français."—Simiand: *Le Salaire*, etc., p. 227. Cf. also pp. 195–196, 196 n.

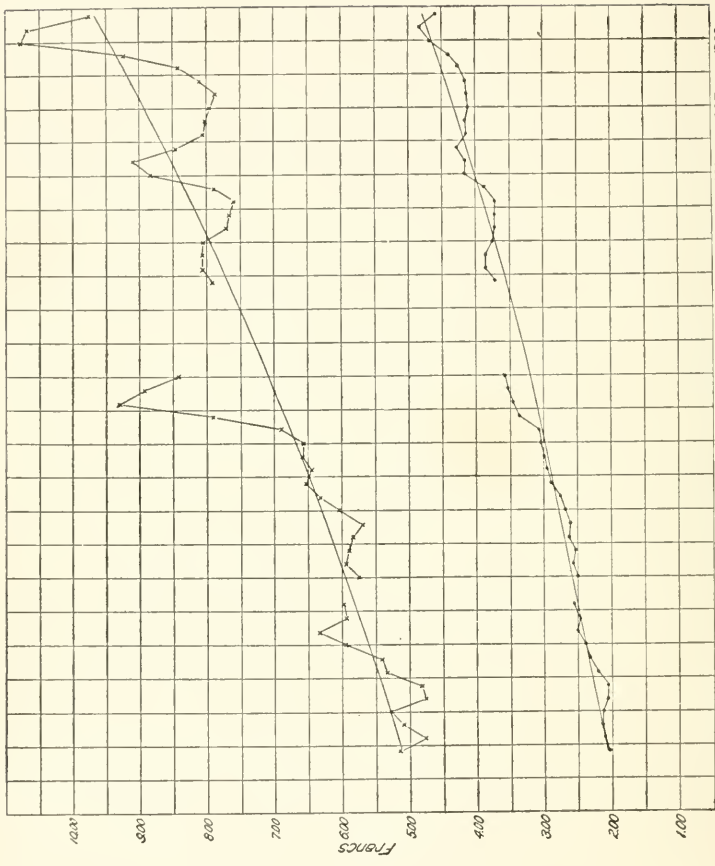

FIGURE 5. — Mean value of daily product per laborer x—x. Mean daily wages ——.

ity of labor is accompanied with a variation of wages in the same direction. That is to say, as an average result, an increase or decrease in the productivity of labor is accompanied with an increase or decrease in wages. This proposition, therefore, is a thesis affecting the fluctuations about the general trend, and consequently, in order to bring the two series to a comparable basis, their differences due to their difference in general trend must be eliminated. Our first problem, then, is to find the equation to the general trend of the figures in each series.

If the type of equation for each series be taken as of the geometric order $y = AB^x$, and the constants A, B be evaluated by the method of moments, the equation to the general trend for the wage series is $y = 2.1063(1.015)^x$, and, for the series of the values of the product, $y = 5.1115(1.012)^x$, the origin, in both cases, being at 1847. The two equations are represented upon Figure 5 by the smooth curves passing through the two series of numbers.

The knowledge of the equations to the curves of general trend makes possible the next step in the problem, which is the computation of the relative deviations of the actual figures from the general trend. The actual figures, as we know, are recorded by the zigzag line. The absolute deviations of the actual figures for the successive years are obtained by subtracting from the actual figure for each year the value of the general trend for the same date. For example, the absolute deviation for 1900, in case of

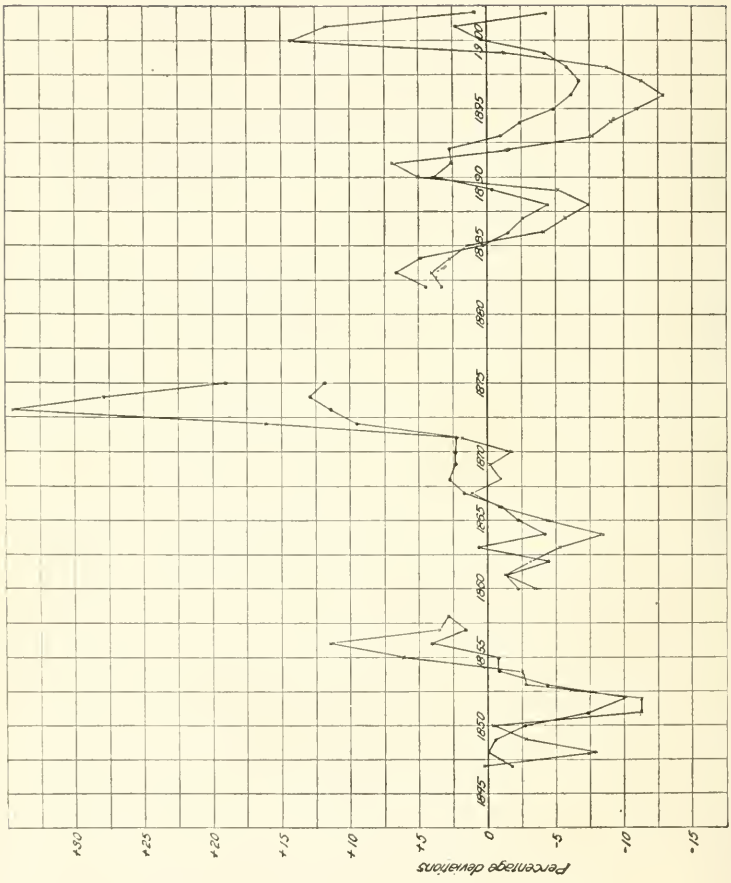

FIGURE 6. — Percentage deviations in the mean value of the daily product per laborer x—x. Percentage deviations in mean daily wages — · —.

the daily product, was $10.78 - 9.43 = 1.35$, because the mean value of the daily product per laborer, in 1900, was 10.78 francs, and the value of the general trend for the same year was $y = 5.1115\ (1.012)^{53} = 9.43$ francs. The relative deviation of the actual figures for each year is the ratio of the absolute deviation to the corresponding value of the general trend. In 1900, the relative deviation was $\frac{1.35}{9.43} = 14.3$ per cent. It is desirable to deal with the relative, instead of the absolute, deviations because the two series of figures move about axes with different absolute values and with different rates of change.

After the relative deviations of the two series of figures have been computed, it is possible to treat their correlation. On Figure 6 the relative deviations of the two series are plotted about a horizontal line. It is quite evident from the general concurrent flow of the curves that the two series of percentage deviations are closely associated. What is the measure of the degree of their correlation?

The computation of the coefficient of correlation by the usual method gives $r = .843$. Figure 7 shows the regression of the percentage deviation in the mean daily wage upon the percentage deviation in the mean value of the daily product per laborer.

We conclude, therefore, from this part of the investigation, that, in case of the great industry of coal mining in France, —

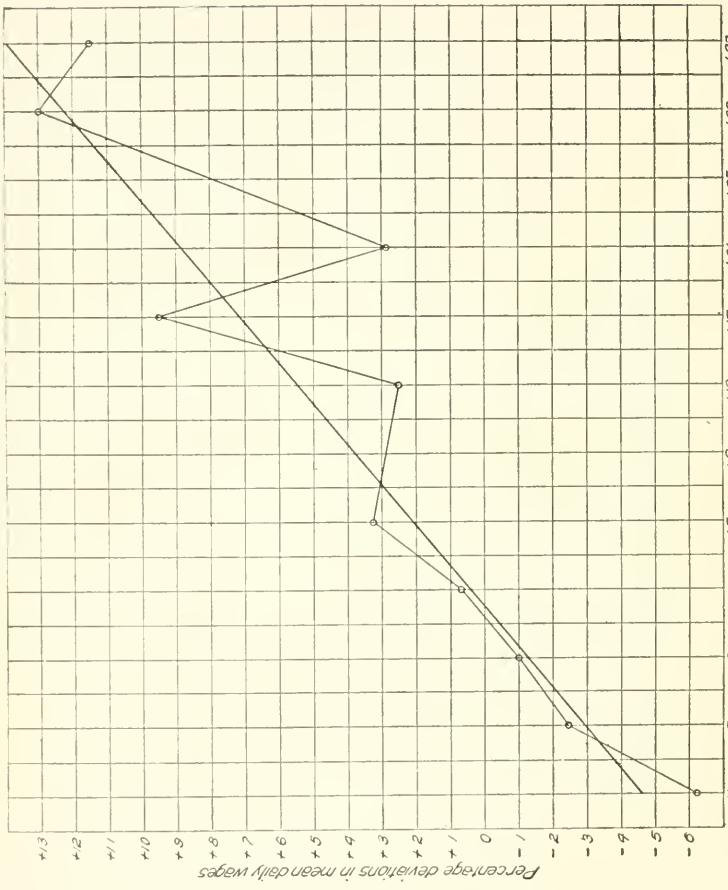

FIGURE 7. — Regression of percentage deviations in mean daily wages upon percentage deviations in the mean value of the daily product per laborer.

(1) the fluctuation in the mean daily rate of wages varies directly with the fluctuation in the mean value of the daily product of the laborer;

(2) the coefficient measuring the degree of association between the percentage variation in the rate of wages and the percentage variation in the mean value of the daily product per laborer has the very high value of $r = .843$.

Fluctuations in the Laborer's Relative Share of the Product and in the Ratio of Capital to Labor.

The second essential proposition in the productivity theory of wages is that the fluctuation in the laborer's relative share in the value of the product varies directly with the fluctuation in the amount of machine power per laborer employed in the industry. The establishment of this proposition in a rigid form would give to the productivity theory in its most important aspect the sanction of inductive proof. For the pure theory of the distribution of income is a theory as to the apportionment of the product of industry between the agents coöperating in its production and is, therefore, concerned with relative shares of the product and not with their absolute magnitudes. Our first proposition concerning the relation of wages to the value of the product is a proposition affecting the absolute value of wages and not the laborer's relative share of the product of industry. The proposition that we are about to ex-

amine is concerned with the latter, more fundamental aspect of the wages question.

Table II in the Appendix exhibits the material upon which the investigation rests. Column II of that table gives, throughout a period of 53 years, the ratio of a day's wages to the value of a day's product per laborer. The two items from which the ratios are derived may be obtained from Table I. Column III, which gives the amount of machine-power per 100 laborers employed in mining, is derived from two items that are taken from M. Simiand's work[1]: (1) the total horse-power of the machinery employed in the mines, and (2) the number of laborers so employed. The figures in column III are the ratios of these two items expressed as the number of horse-power per 100 laborers. The problem that will be investigated is the relation of the variations of the figures in column II to the variations in column III.

It would have been desirable to investigate directly the relation of the variation of the laborer's share of the product to the variation of the amount of capital associated with labor in production. But the figures for the capital employed, at successive years, were not accessible to me. The proposition in the form in which it will be tested is of first importance in itself, and if it is permitted to make the reasonable assumption that the machine-power employed in mines is directly related to the amount of capital employed, then the

[1] Simiand: *Le Salaire*, p. 49.

establishment of the proposition in its present form renders practically certain the doctrine of pure economics that the laborer's relative share of the product varies directly with the relative amount of capital with which he works.

A moment ago reference was made to the exploitative implication in Von Thünen's treatment of the productivity principle. To affirm that the marginal product of labor decreases with an increase in the labor force and that the general rate of wages falls with the decrease of the marginal product, leaves room for the inference that the earlier laborers are exploited of a part of their product when, in consequence of the growth of the labor force, the marginal product of labor decreases. Professor Clark, as we know, has shown why such an inference is unwarranted. The explanatory facts are that the increase of the labor force implies a reduction in the average amount of capital with which the laborer works, and that the fall of the general rate of wages is due to a lessened specific productivity of labor following the per capita reduction of the amount of capital employed. Has this theory relevancy only to the hypothetical static state that forms the groundwork of theoretical speculation, or does it have a bearing upon the highly dynamic conditions of actual industry? The investigation that we are about to enter upon will answer the question.

Our present query has this form: Does the fluctuation in the laborer's relative share of the product of

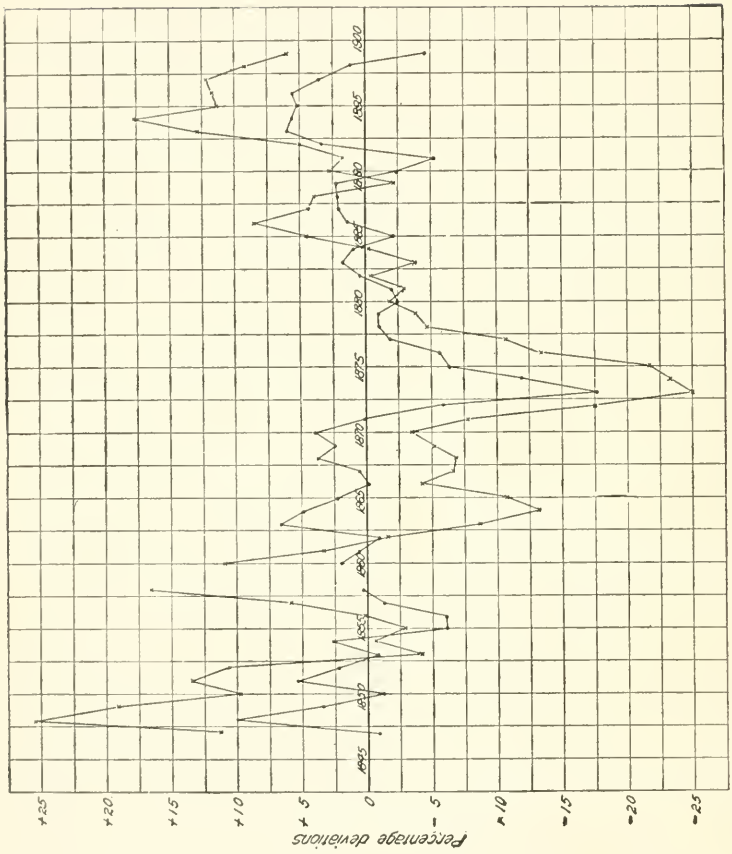

FIGURE 8. — Percentage deviations in the ratio of machine-power to one hundred laborers x—x. Percentage deviations in the ratio of mean daily wages to the mean value of the daily product per laborer ·—· .

industry vary directly with the fluctuation in the relative amount of machine-power with which he works, and if so, how closely are the concomitant variations related?

The method of investigation is the same as the one we have already employed. If the quantities in columns II and III of Table II are plotted, the graphs will take a generally ascending zigzag course. The equation to the general trend, in case of the ratio of wages to the value of the product, is $y = 40.756(1.0039)^x$, and, in case of the ratio of machine-power to men, $y = 28.758(1.025)^x$, the origin in both cases being 1847. On Figure 8 the percentage deviations are traced about a horizontal line, and on Figure 9 the regression of the percentage deviation of the first series upon the percentage deviation of the second series is shown, that is to say, the regression of the percentage deviations, in case of the ratio of wages to the value of the product, upon the percentage deviations in case of the ratio of machine-power to men. The coefficient of correlation is $r = .599$.

We conclude, so far as the industry of coal mining in France is concerned,—

(1) that the fluctuation in the laborer's relative share of the product of industry varies directly with the fluctuation in the relative amount of machine-power with which he works;
(2) that the coefficient of correlation is $r = .599$.
(3) that if it is permitted to assume that the

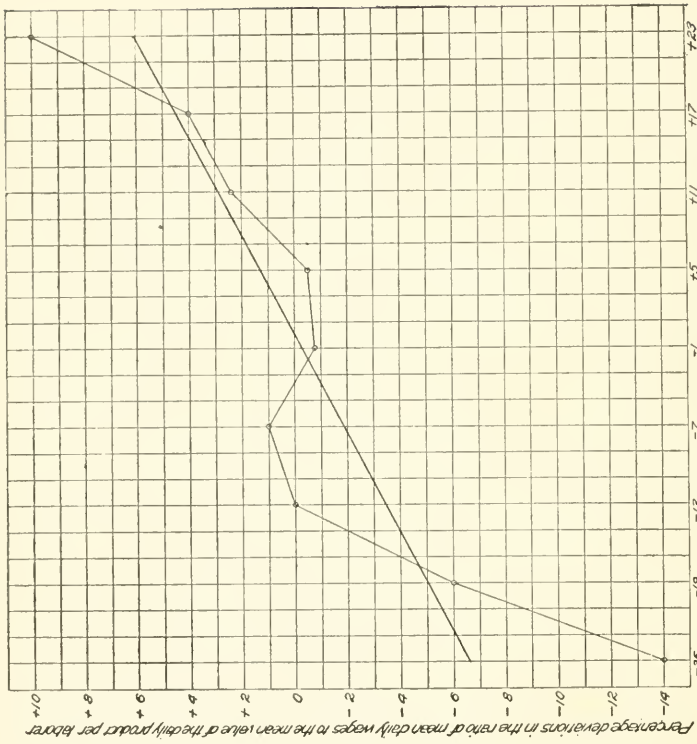

FIGURE 9. — Regression of percentage deviations in the ratio of mean daily wages to the mean value of the daily product per laborer, upon the percentage deviations in the ratio of machine-power to one hundred laborers.

amount of machine-power varies directly with the amount of capital employed, then the fluctuation in the laborer's relative share of the product of industry varies directly with the fluctuation in the relative amount of capital employed.

The General Trend of Wages.

The third essential proposition in the productivity theory of wages is that, other conditions remaining the same, the general trend of the laborer's relative share of the product is dependent upon the ratio in which capital and labor are combined in production. Up to this point we have been concerned with fluctuations about the general trend of wages; we now enter upon the question of the general trend itself. This corollary of the productivity theory is a proposition in dynamic economics; it concerns the reward of the laborer in a society in which conditions and methods of production are changing, and consequently it has a very direct bearing upon concrete industry.

Because of the lack of data to treat this proposition fully, we shall be compelled to approach the problem by investigating, in a particular instance, a corollary of the proposition before us. We observe, then, that if it be true that the general trend of the laborer's relative share of the product of industry increases with the relative amount of capital with which he works, it would follow that, in the same industry, in

neighboring places, with similar methods of production, the general trend of the laborer's share would increase most rapidly where the general trend of the relative amount of capital per laborer employed increased most rapidly. Or, to put the corollary in a form in which it will admit of treatment by means of available statistics, we may say that in case of the same industry, in neighboring places, other conditions remaining the same, the general trend of the laborer's relative share of the product will increase most rapidly where the general trend of machine power per laborer increases most rapidly.

Table III in the Appendix exhibits the data used in the investigation. Column II gives the ratio, per hundred laborers, of the machine-power employed in the direct exploitation of the coal mines in the *Bassin de Nord*. Column III gives, for the same basin and the same period, the ratio of daily wages per laborer to the value of the daily product per laborer. Columns IV and V give the corresponding data for the neighboring *Bassin de Pas-de-Calais*. All of the figures have been taken from M. Simiand's work.[1] The record for the period 1880–1902 is used because the figures for the years before 1880 are not comparable with those for the later period. M. Simiand gives figures for only three basins — *Loire*, *Nord*, and *Pas-de-Calais*. The methods of exploitation and the general conditions of production in case of the neighboring basins *Nord* and *Pas-de-Calais* are regarded by M.

[1] Simiand: *Le Salaire*, p. 112.

Simiand as being so much alike as to justify his classing them together[1] and treating them in sharp contrast to the southerly *Bassin de Loire*.

It is quite clear, therefore, that the *Bassin de Nord*, and the *Bassin de Pas-de-Calais*, because of their being in neighboring *départements*, because of the similar methods of exploitation and the similar general conditions of production, and because of the existence of statistical material covering a long period, offer a favorable case for testing the corollary that has just been formulated.

Our immediate problem is to find, for the two coal basins, the general trend of the increase, first of the ratio of the machine-power per hundred laborers, and secondly, of the ratio of wages to the value of the product. In case of the data as to the ratio of machine-power to the number of men, we find, by using the same method that has already been employed in this chapter, that the equation to the general trend for the *Bassin de Nord* is $y = 46.815(1.0504)^x$, and for the *Bassin de Pas-de-Calais*, $y = 61.793(1.0344)^x$, the origin in both cases being at 1880. As both of

[1] Simiand: *Le Salaire*, pp. 110–111. "Il suffit à notre dessein de considérer les bassins dont l'importance domine et règle l'évolution globale et d'atteindre les cas d'évolution économique les plus divergents que nous puissions rencontrer. Or, il se trouve qu'à tous les moments de notre expérience, Loire, Nord et Pas-de-Calais fournissent à eux seuls la plus grosse part de la production française totale (d'abord sensiblement plus de la moitié, ensuite jusqu'à 70% et plus). Puis une étude antérieure nous a indiqué que le bassin de la Loire d'une part, les bassins du Nord et du Pas-de-Calais de l'autre, semblaient s'opposer le plus nettement au point de vue de la conduite économique."

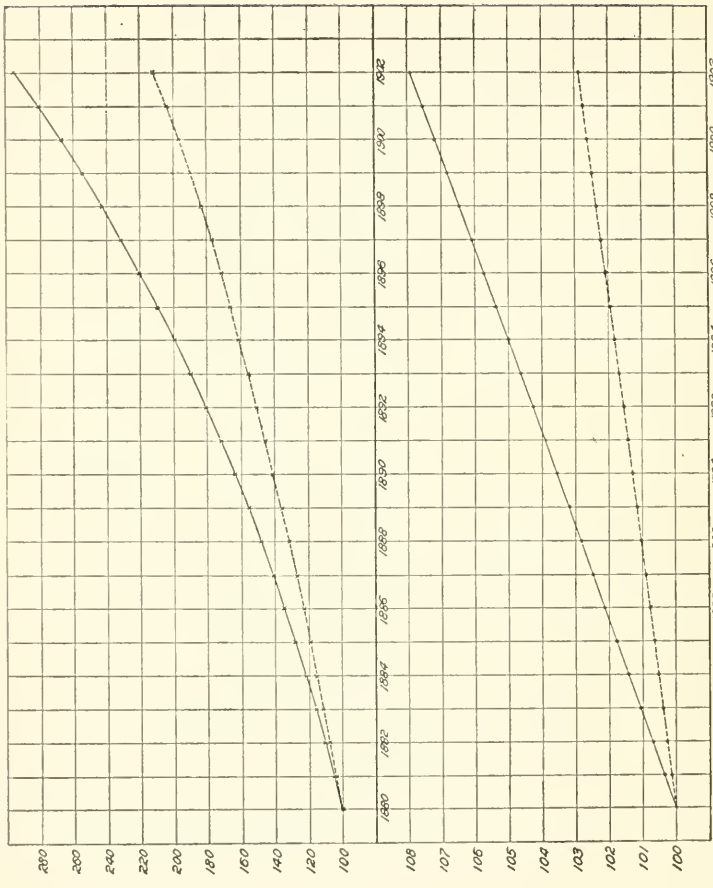

FIGURE 10. — Upper part: Comparative increase in machine-power per one hundred laborers. Nord ×—×. Pas-de-Calais ×---×.
Lower part: Comparative increase in the ratio of daily wages to the value of the daily product per laborer. Nord —. . Pas-de-Calais ----- .

these equations are of the geometric form, it follows that the ratio of annual increase in the ratio of machine-power per hundred men, for the *Bassin de Nord* is 1.0504, and for the *Bassin de Pas-de-Calais* is 1.0344. Hence, as the *Bassin de Nord* offers the greater ratio of increase, we should expect to find, according to the principle of the productivity theory, that the ratio of the laborer's relative share in the product increased more rapidly in the *Bassin de Nord* than in the *Bassin de Pas-de-Calais*. Before passing to the question of wages, we should note that, if the equations to the general trend for the relative machine power in the two cases be put in the form, respectively, of $y = 100(1.0504)^x$, and $y = 100(1.0344)^x$, the upper part of Figure 10 will represent the relative ratios of increase for the two basins.

In case of the data as to the ratio of wages to the value of the product, we find that the equation to the general trend for the *Bassin de Nord* is $y = 49.139(1.0035)^x$, and for the *Bassin de Pas-de-Calais*, $y = 44.697\ (1.0013)^x$, the origin in both cases being at 1880. The ratio of the annual increase in the former case is 1.0035 and in the latter case it is 1.0013. If the two equations be put in the form of $y = 100\,(1.0035)^x$ and $y = 100\,(1.0013)^x$, respectively, the lower part of Figure 10 will represent, for the two basins, the ratios of increase of the laborer's relative share of the product.[1]

[1] In order to make visible the ratios of growth in the two cases, the upper and the lower parts of Figure 10 are drawn to different perpendicular scales.

We find, accordingly, that, true to the principle of the productivity theory, —

(1) the general trend of the laborer's share of the product is upward where the general trend of machine-power per laborer is upward;
(2) the ratio of increase in the general trend of wages is greater, the greater the ratio of increase in the relative amount of machine-power with which the laborer works.

If it is reasonable to assume that the amount of machine-power employed in coal mining varies directly with the amount of capital employed, the preceding investigation justifies the conclusion that the increase in the general trend of the laborer's share of the product is greater, the greater the increase in the general trend of the ratio of capital to labor employed in production.

The conclusions of this chapter have, for the most part, been expressed in general form, while the material upon which the investigation rests has been drawn from the history of one industry in one country. This has been done with no intention of exaggerating the scope of the inductive inferences nor in ignorance of the narrow statistical basis upon which the last proposition rests. The purpose of the investigation was to make the connection between certain general conclusions of pure economics and the concrete facts of some one great industry. The general character of

the propositions is due to their *a priori* origin; the investigation has established that, far from being without relevancy to actual industry, these general propositions are the accurate description of the economic laws of wages in the one great industry that has been subjected to inductive treatment.

APPENDIX

TABLE I.— Daily Wages and Mean Value of Daily Product per Laborer

Year	Mean Daily Wages	Mean Value of the Daily Product per Laborer	Year	Mean Daily Wages	Mean Value of the Daily Product per Laborer
I	II	III	I	II	III
1847	2.07	5.13	1875	3.58	8.41
1848	2.14	4.76	1876	——	——
1849	2.16	5.09	1877	——	——
1850	2.14	5.27	1878	——	——
1851	2.07	4.75	1879	——	——
1852	2.04	4.81	1880	——	——
1853	2.20	5.32	1881	——	——
1854	2.32	5.40	1882	3.71	7.91
1855	2.35	5.95	1883	3.84	8.06
1856	2.51	6.32	1884	3.83	8.06
1857	2.48	5.93	1885	3.72	8.05
1858	2.55	5.97	1886	3.71	7.71
1859	——	——	1887	3.72	7.65
1860	2.50	5.73	1888	3.71	7.60
1861	2.57	5.94	1889	3.87	7.88
1862	2.52	5.89	1890	4.16	8.84
1863	2.69	5.83	1891	4.17	9.09
1864	2.60	5.69	1892	4.24	8.46
1865	2.69	6.02	1893	4.14	8.03
1866	2.76	6.31	1894	4.14	8.01
1867	2.89	6.52	1895	4.10	7.93
1868	2.96	6.45	1896	4.10	7.86
1869	2.99	6.58	1897	4.14	8.08
1870	3.04	6.55	1898	4.23	8.41
1871	3.08	6.88	1899	4.38	9.21
1872	3.35	7.91	1900	4.66	10.78
1873	3.45	9.30	1901	4.82	10.68
1874	3.56	8.93	1902	4.57	9.75

TABLE II. — Ratio of Daily Wages to the Value of a Day's Product per Laborer and Ratio of Machine-Power to One Hundred Laborers

Year	Ratio of Daily Wages to the Value of a Day's Product per Laborer	Ratio of Machine-Power to 100 Laborers	Year	Ratio of Daily Wages to the Value of a Day's Product per Laborer	Ratio of Machine-Power to 100 Laborers
I	II	III	I	II	III
1847	40.4	32	1874	39.9	43
1848	45.0	37	1875	42.6	45
1849	42.5	36	1876	43.1	51
1850	40.7	34	1877	45.0	54
1851	43.6	36	1878	45.5	59
1852	42.5	36	1879	45.7	61
1853	41.4	32	1880	45.2	64
1854	43.0	34	1881	45.6	65
1855	39.5	34	1882	46.9	68
1856	39.7	36	1883	47.7	67
1857	41.8	39	1884	47.5	72
1858	42.7	44	1885	46.2	77
1859	——	—	1886	48.1	82
1860	43.7	44	1887	48.6	81
1861	43.3	42	1888	48.8	82
1862	42.8	41	1889	49.1	79
1863	46.2	39	1890	47.0	85
1864	45.7	38	1891	45.8	87
1865	44.7	40	1892	50.2	92
1866	43.8	44	1893	51.7	100
1867	44.3	44	1894	51.7	108
1868	45.9	45	1895	51.7	105
1869	45.5	47	1896	52.1	108
1870	46.4	49	1897	51.3	111
1871	44.8	48	1898	50.3	111
1872	42.3	44	1899	47.6	110
1873	37.1	41			

TABLE III. — Ratio of Machine-Power to One Hundred Laborers and Ratio of Daily Wages to the Value of a Day's Product per Laborer

Year	Bassin de Nord		Bassin de Pas-de-Calais	
	Ratio of Machine-Power to 100 Laborers	Ratio of Daily Wages to the Value of a Day's Product per Laborer	Ratio of Machine-Power to 100 Laborers	Ratio of Daily Wages to the Value of a Day's Product per Laborer
I	II	III	IV	V
1880	45	48.7	64	40.2
1881	46	49.3	63	42.3
1882	48	49.0	71	45.0
1883	50	49.9	72	45.2
1884	58	51.5	70	45.7
1885	68	50.1	70	44.1
1886	69	50.6	85	45.8
1887	71	49.9	82	46.6
1888	77	49.9	83	46.5
1889	77	48.8	79	47.4
1890	82	47.4	75	44.3
1891	79	45.5	78	40.9
1892	85	50.0	83	47.5
1893	90	51.8	94	49.5
1894	91	56.7	115	48.4
1895	90	57.9	104	49.0
1896	95	56.8	101	49.8
1897	93	55.3	110	49.2
1898	92	53.7	109	49.0
1899	107	51.6	97	44.5
1900	137	45.8	125	39.8
1901	153	50.5	149	42.2
1902	156	52.7	146	42.1

CHAPTER IV

WAGES AND ABILITY

"Le capitalisme . . . tend à produire une certaine égalisation du travail entre les diverses parties de l'usine; mais comme il a besoin d'un nombre considérable d'hommes particulièrement actifs, attentifs ou experimentés, il s'ingénie à donner des suppléments de salaire aux hommes qui lui rendent ainsi plus de services; ce n'est point par des considérations de justice qu'il se règle dans ce calcul, mais par la seule recherche empirique d'un équilibre réglé par les prix. Le capitalisme arrive donc à résoudre un problème qui semblait insoluble, tant qu'il avait été étudié par les utopistes; il résout la question de l'égalité des travailleurs, tout en tenant compte des inégalités naturelles ou acquises qui se traduisent par des inégalités dans le travail."

—Georges Sorel.

In the preceding chapter we examined statistically the most important aspects of the first of the two inquiries that are faced in a complete theory of wages, namely, the question as to the law and cause of the variation in the share of the product of industry constituting general wages. In the present chapter we shall be concerned with the second of these fundamental inquiries, namely, with the law and cause of the distribution of general wages among the members of the labor group. Our point of departure is Professor Marshall's treatment of the topic.

"We may then regard competition, or, to speak more exactly, economic freedom and enterprise, as tending to make time-earnings in occupations of

equal difficulty and in neighbouring places not equal, but proportionate to the efficiency of the workers."[1] The sense in which Professor Marshall uses the word "efficiency" is to be inferred from the context. He defines "*efficiency-wages*" as "earnings measured, not as time-earnings are with reference to the time spent in earning them; and not as piece-work earnings are with reference to the amount of output resulting from the work by which they are earned; but with reference to the exertion of ability and *efficiency* required of the worker."[2] In the fourth book of the *Principles of Economics*, Chapter V opens with this sentence: "We have next to consider the conditions on which depend health and strength, physical, mental and moral. They are the basis of industrial efficiency, on which the production of material wealth depends." Elsewhere,[3] Professor Marshall asserts "that what makes one occupation higher than another, what makes the workers of one town or country more efficient than those of another, is chiefly a superiority in general sagacity and energy which is not specialized to any one trade." From these references it may be inferred that the term "efficiency" when applied in the theory of wages in a subjective sense[4] means a balance of physical, mental, and moral

[1] *Principles of Economics.* 4th edit., p. 630.

[2] *Ibid.*, pp. 630-631. [3] *Ibid.*, p. 286.

[4] The word "efficiency" is one of a large group of terms — such as belief, truth, probability — in which there is ambiguity due to their having both a subjective and an objective connotation. The two meanings of "efficiency" in the theory of wages should be carefully discriminated.

qualities, which is felicitously summarized in the phrase "general sagacity and energy."

Is there any ground for believing that this general theory has any relation whatever to the conditions of wage receiving in actual industry? Suppose the relevancy of the theory were denied, — as indeed it is denied frequently and vehemently, — how could one proceed to fortify it otherwise than by reverting to remote hypothetical premises and repeating the long chain of logical deductions? If the theory is to be accepted as a law, using the word law in the sense of our first chapter, it must rest upon the concrete facts of industry.

A similar position is to be assumed in approaching the explanation of wages from the inductive side. The conclusion upon this topic of the French *Office du Travail*, in its voluminous report on wages for 1893–1897, is summarized in these words: "On voit entre quelles limites étendues varie la valeur relative du salaire dans les diverses professions. Cette valeur relative dépend essentiellement de la rareté des aptitudes intellectuelles et physiques nécessaires à l'ouvrier, du degré de développement de ces mêmes aptitudes qu'exigent les diverses professions." [1]

It is entirely true that one does see from the statistical schedules that there is a wide variation in relative wages, but in the whole of the four volumes of the report there is not a word to show a quanti-

[1] *Salaires et durée du travail dans l'industrie française.* Vol. I, p. 512.

tative relation between the amount of wages and "la rareté des aptitudes intellectuelles et physiques" of the laborer. So far as the use of words is concerned, administrative inquiry and pure theory take common ground. Would it be possible through the discovery of an economic law to bring the two together so that the theory might organize the data and the data support the theory?

An Hypothesis as to the Distribution of Ability.

Before we can establish a quantitative relation between wages and ability we must have an hypothesis as to the distribution of ability among a representative class of laborers. The particular hypothesis that is put forward in this chapter is that industrial ability — general sagacity and energy — is distributed according to the normal or Gaussian law.

The normal, or Gaussian, law is represented graphically in Figure 11 by either of the two curves *AMB*, *amb*. If from a homogeneous group of men a large number of measurements of any physical character are made, for example of stature, it will be found that the measurements may be arranged in such a way that the relative frequencies of the deviations from the average measurement will, when plotted, produce a curve approximating this type. A deviation in excess of the average stature is measured to the right of point *O*, on the line *ox*, and the corresponding frequency of the deviation is then plotted perpendicularly at the end of the

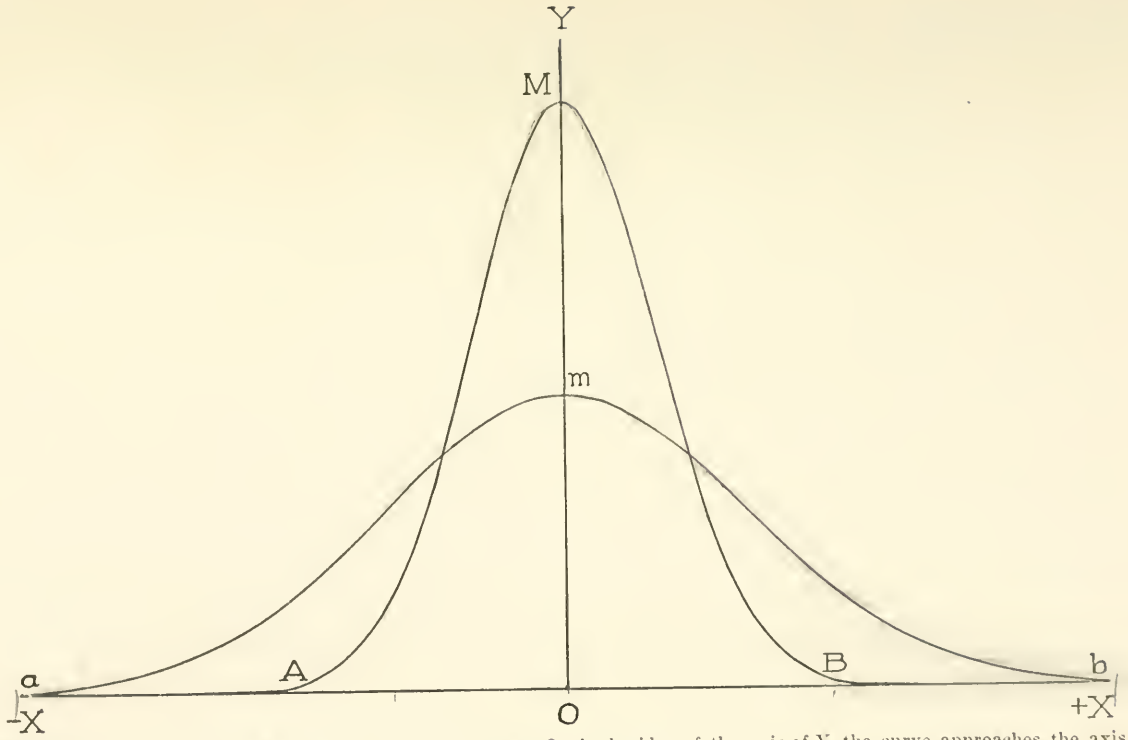

FIGURE 11. — Illustrating the normal or Gaussian curve. On both sides of the axis of Y, the curve approaches the axis of X as an asymptote.

deviation. Similarly, deviations below the average are measured to the left of point *O*. The two sides of the curve are symmetrically disposed about the maximum ordinate, and the scatter of the measurements about this ordinate varies with the standard deviation of the measurements. The standard deviation of the curve *amb* is twice that of the curve *AMB*.

Grounds for the Hypothesis.

In justification of the hypothesis that has just been described the following considerations are offered: —

(1) The accumulation of a great number of measurements of physical characters, which was begun by Quételet and is now carried forward with zeal by anthropologists and biometricians, has established that physical qualities are distributed according to the Gaussian law. "We have very definite evidence that the normal curve suffices to describe within the limits of random sampling the distribution of the chief physical characters in man." [1]

(2) Several years ago Sir Francis Galton began his studies of inheritance on the assumption that the mental and moral qualities of man are distributed according to the same law as are physical qualities. Professor Pearson's laborious investigations of mental char-

[1] Karl Pearson: *Biometrika*, Vol. II, p. 395.

acters proceeds upon the same assumption: "We have . . . selected, as the normal scale of intelligence, that which would be given if the frequency distribution of intelligence followed the normal, or Gaussian, curve of errors. Whatever the true scale may be, it can only be a more or less — probably less — distorted form of this scale." [1]

(3) It has been pointed out that industrial efficiency is dependent upon physical, mental, and moral qualities, and these qualities, according to the preceding paragraphs, there is good reason for regarding as being distributed according to the Gaussian law. Professor Edgeworth has demonstrated a theorem to the effect that ". . . if a variable thing obey the normal law, a function of that thing will obey the normal law." [2] Professor Edgeworth however gives the warning that "this property holds only commonly, not universally."

[1] Karl Pearson: *Biometrika*, Vol. V. p. 106. "An *a priori* justification of the scale may be found in the fact that the plotted points of the regression curves are for a number of pairs of characters, within the limits of random sampling, on a straight line when such a scale of intelligence is used." *Ibid.*, pp. 106–107.

[2] *Journal of the Royal Statistical Society*, December, 1898, p. 676.

The Expression of the Gaussian Law in a Form that will facilitate the Testing of the Differential Theory of Wages.

In the subsequent part of this chapter we shall refer to the theory concerning the law and cause of the distribution of general wages among the members of the labor group as the differential theory or the differential hypothesis of wages.

The statement of the differential hypothesis by the most approved authorities contains four leading propositions: —

(1) The labor force in a country of varied industries is a force of varying efficiency per laborer unit;

(2) The character of the industrial organization of a particular time and place determines the nature and degree of segregation of laborers into groups of varying efficiency. The two most fundamental groups are those of skilled and of unskilled labor;

(3) The laborer of least efficiency in each group receives a wage which constitutes the minimum wage of the group. This minimum wage is not less than the highest wage that could be earned by the least efficient member of the group in the other forms of employment which are open to him;

(4) The more efficient laborers within a group receive the minimum wage of the group plus

> a supplement proportionate to the excess of their efficiency over that of the least capable laborer in the same group.

We have assumed that the distribution of ability among a large group of laborers follows the Gaussian law. But this law is a generalization applying to an infinite number of measurements, whereas the statistics of wages are available for only a finite number of laborers. Furthermore, according to the differential hypothesis, wages are distributed among laborers proportionately to their differential ability. But the Gaussian law gives the law of the distribution of ability for the aggregate of laborers: it does not describe how the individuals in the aggregate differ from each other. It is therefore necessary to derive from the Gaussian law a formula that will be applicable to a finite group and will express the average differences in ability among the members of such a group.

In 1902 Sir Francis Galton proposed to British mathematicians this problem: "A certain sum, say £100, is available for two prizes to be awarded at a forthcoming competition; the larger one for the first of the competitors, the smaller one for the second. How should the £100 be most suitably divided between the two? What ratio should a first prize bear to that of a second one? Does it depend on the number of competitors, and if so, in what way? Similiar questions may be asked . . . when the number of prizes exceeds two. What should be the

division of the £100 when three prizes are to be given, or four, or any larger number?"[1] Mr. Galton's investigation suggested "that when only two prizes are given in any competition, the first prize ought to be closely three times the value of the second." The novelty and interest of the problem led him to conclude: "I now commend the subject to mathematicians in the belief that those who are capable, which I am not, of treating it more thoroughly, may find that further investigations will repay trouble in unexpected directions."

Professor Karl Pearson answered the appeal to mathematicians and undertook the solution of the problem in this general form: "A random sample of n individuals is taken from a population of N members which when N is very large may be taken to obey any law of frequency expressed by the curve $y = N\phi(x)$, ydx being the total frequency of individuals with characters or organs lying between x and $x+dx$. It is required to find an expression for the average difference in character between the p^{th} and the $(p+1)^{th}$ individuals when the sample is arranged in order of magnitude of the character."

"I propose to call this general problem: *Francis Galton's Individual Difference Problem in Statistics*, or, more briefly, *Galton's Difference Problem*. It will be seen at once to carry us from the consideration of the means and standard deviations of mass aggregates

[1] Francis Galton, F.R.S.: "The most Suitable Proportion between the Values of First and Second Prizes." *Biometrika*, Vol. I, p. 385.

and arrays to the average interval between individuals of those aggregates. We may still deal with averages, but we fix our attention no longer on the whole population, but on definite individuals in its ordered array. This I believe to be a real advance in statistical theory." The solution of the problem "provides us for the first time, I believe, with most probable relationships between individuals forming a random sample." [1]

One would think that this mathematical problem had been formulated and solved with a view to the application of the results to our problem of the differential hypothesis of wages! For the knowledge of the average difference in ability between each of 1000 laborers and his less efficient neighbor, when the whole number are ranked according to their ability, would afford data for determining the average difference in ability of the 999 laborers over their least efficient associate. Moreover, if the 1000 laborers were separated into two groups, the one composed of the less efficient, and the other the more efficient, thus giving rise to a minimum wage in each group, the knowledge of the average difference in efficiency in the population of 1000 would suffice for the computation of the average difference in efficiency of the members in each group over that of the least efficient member of the same group. To solve our problem of wages, the first need is the construction of a Standard Population in which the average differences in ability

[1] Karl Pearson: "Note on Francis Galton's Problem." *Biometrika*, Vol. I, pp. 390–399.

of its members are computed. Such a Standard Population, judiciously used, would supply the means with which to obtain a first approximation to the solution of several questions in the dynamics of wages.

The Standard Population.

In the Appendix to this chapter are two mathematical tables: Table I, Average Differential Ability in a Population of One Hundred; Table II, Standard Population of One Hundred. A detailed account of the construction of these tables is given in the Appendix. Before proceeding to the description of Table II, upon which the investigation of this chapter is based, it may be observed that Table I enables us to answer the question as to the form of distribution of wages when the incomes of laborers are apportioned entirely according to ability. For example, in 1900, in the manufactures of the United States, the average wage of males over sixteen years of age was $11.43 per week. The aggregate received by a population of 100 would therefore be $1143. Assuming the minimum wage to be $3.13[1] then, if wages were distributed entirely according to ability, each of the more sagacious and energetic laborers would receive the minimum wage $3.13, plus a supplement proportionate to his differential ability. That is to say, 99 laborers would each receive $3.13 plus a share of $830 (1143 − 313), which would vary proportionately

[1] The reason for this assumption will appear later.

to the excess of his ability over that of the least capable member of the group. The $830 would therefore be distributed according to the conditions of columns IV and VIII in Table I. The ablest man would receive $3.13 plus (830) (.02) which is $3.13 plus $16.60 = $19.73. Similarly, the wages of the other laborers would be ascertained. A graphic description of the resulting distribution is given in the accompanying Figure 12, where wages are taken upon the axis of x and the relative frequencies of the several rates of wages are plotted parallel to the axis of y. The Gaussian curve traced upon the figure is practically an exact fit[1] to the data.

Table II, The Standard Population of One Hundred, is designed to meet the difficulty of the segregation of labor, in actual industry, into groups of skilled and of unskilled labor. It is based upon the knowledge of the average differences in ability between members of a group of 100. The total population of 100 is divided into an upper group corresponding to skilled labor, composed of the fifty ablest members; and a lower group corresponding to unskilled labor, composed of the less capable members. The two groups are then treated separately, just as the whole population was treated in Table I; that is to say, each group of fifty is considered as forming a separate population. The average differences in ability of the fifty ablest members over the ability of the fifty-first member —

[1] According to the Pearsonian test, $n^1 = 17$ and $\chi^2 = .942782$, which is a perfect fit.

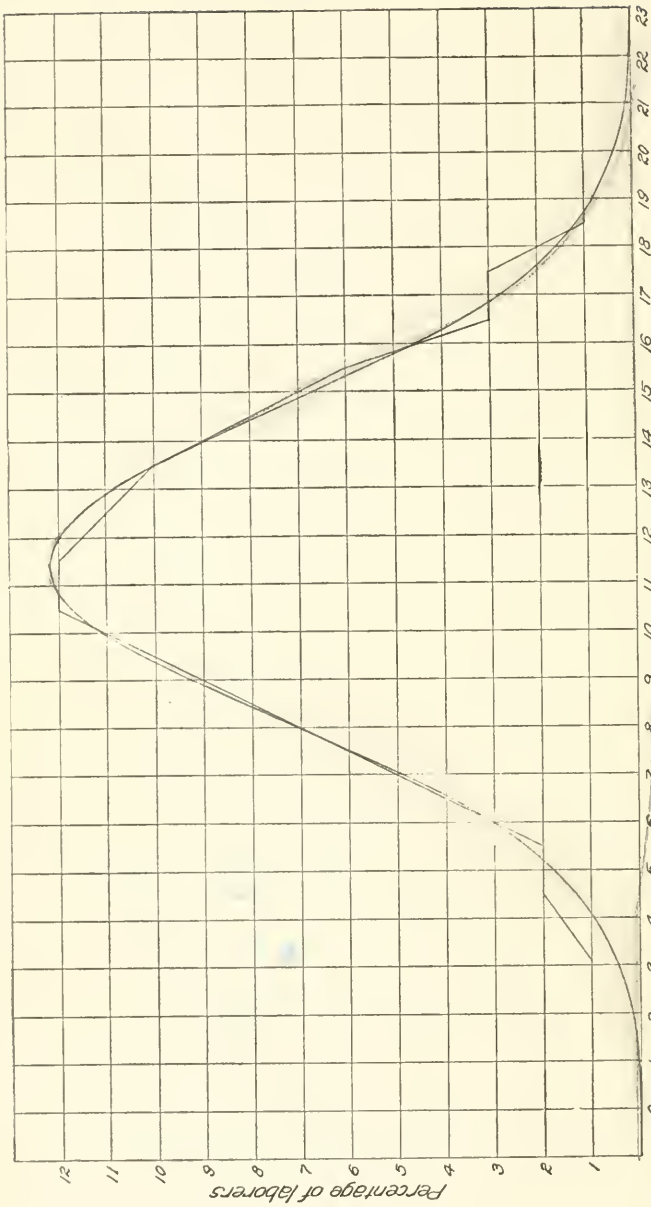

FIGURE 12. — Illustrating the distribution of wages according to differential ability.

who is the ablest member of the lower group — are then computed. Likewise the average differences in ability of the members of the lower group over the ability of the least capable member of that group are ascertained. In columns III and VII these differences are expressed in terms of the standard deviation of the group, and in columns IV and VIII the same individual differences are respectively expressed as percentages of the sum of the differences. The method in which this table is used to bring to a statistical test the differential hypothesis as to the distribution of wages will now be rendered clear by means of examples.

The Application of the Theory of the Standard Population.

Certain principles must be observed in selecting data to test the theory: —

(1) The differential hypothesis is based upon the assumption of perfect competition of laborers. To meet this specification, (*a*) we have taken data only from adult male laborers in manufacturing industries, where competition among laborers is keenest, and (*b*) have made a supplementary hypothesis — designed to meet the difficulty of non-competing groups — to the effect that the labor force is divided into two groups, the members of each of which receive the minimum wage of their respective groups plus a supplement proportionate to their differential ability.

(2) The differential hypothesis is based on the assumption of conditions of wage earning in a limited area — "in neighboring places," to use Professor Marshall's phrase. Accordingly, in order to avoid complications of differences due to geographical separation, the following data refer, as far as possible, to conditions in homogeneous areas.

(3) The differential hypothesis is based upon the assumption that opportunities for work are sufficiently varied to permit each laborer to exploit to the full his special degree of sagacity and energy. By confining the selection of data to general manufactures instead of particular trades, this condition of the theory is approximated.

We shall now consider in detail the application of the theory.

(*a*) Wages in France.

In Vol. I of the report of 1893 on *Salaires et durée du travail dans l'industrie française*, p. 496, there is the following table giving the distribution of wages in the *Département de la Seine:* —

TABLE I. — Distribution of Laborers according to Rates of Wages per Day. France

Rate in Francs	Number	Rate in Francs	Number
2.75 and less	173	7.25– 7.75	1,359
2.75–3.25	137	7.75– 8.25	552
3.25–3.75	453	8.25– 8.75	232
3.75–4.25	1,172	8.75– 9.25	133
4.25–4.75	1,271	9.25– 9.75	76
4.75–5.25	2,182	9.75–10.25	137
5.25–5.75	1,351	10.25–11.25	30
5.75–6.25	1,551	11.25–12.25	15
6.25–6.75	1,403	More than 12.25	19
6.75–7.25	1,558	Total	13,804

This table describes the actual conditions of wage receiving among 13,804 representative workmen.

In order to apply the differential hypothesis we must first settle upon the wage to be used as a minimum wage in the lower group of the Standard Population. The total range of the Standard Population of One Hundred is 5.02 times the standard deviation (2.52 + 2.50), which gives a half-range of 2.51 times the standard deviation. If, now, we refer to a table of the values of the probability integral in terms of the standard deviation,[1] we find that, on the average, six cases in a thousand exceed 2.51 times the standard deviation. Consequently, in order to make the Standard Population of One Hundred applicable to the French schedule affecting 13,804 laborers, we have substracted from each end of the total series 83 members, that is, (.006) (13,804). This would

[1] The best table is that of W. F. Sheppard: "New Tables of the Probability Integral." *Biometrika*, Vol. II, pp. 174–190.

leave 90 members in the lowest group and 118 in the group 9.75 – 10.25. If the lowest limit of actual wages be supposed to be 2 francs, we should then find the theoretical minimum for the Standard Population from the following proportion 173 : .75 :: 83 : x. As x in this proportion is 36 centimes, the theoretical minimum wage is 2.36 francs. Similarly, the superior limit of wages in the actual figures would be reduced to 10.18 francs. The modified schedule would then appear as in the first and second columns of the following table: —

TABLE II. — Percentage Distribution of Laborers according to Daily Rates of Wages in the Département de la Seine and in the Standard Population

Département de la Seine			Standard Population	
I	II	III	IV	V
Rate in Francs	Number	Percentage	Rate in Francs	Number
2.55	90	.66	2.36	1
3.00	137	1.00	3.00	2
3.50	453	3.33	3.50	4
4.00	1172	8.59	4.00	6
4.50	1271	9.32	4.50	10
5.00	2182	16.00	5.00	13
5.50	1351	9.91	5.50	14
6.00	1551	11.38	6.00	12
6.50	1403	10.29	6.50	11
7.00	1558	11.42	7.00	9
7.50	1359	9.96	7.50	7
8.00	552	4.05	8.00	4.5
8.50	232	1.70	8.50	3.5
9.00	133	.97	8.98	1
9.50	76	.56	9.31	1
9.96	118	.86	9.91	1
Total	13638	100.00	Total	100

Having determined the theoretical minimum wage for the Standard Population, we now find by means of the first and third columns in the above Table II that the average wage in the manufactures of the *Département de la Seine* was 5.864 francs per day, and that the first fifty per cent of the laborers — that is the less capable laborers — received 39.819 per cent of the total wage dividend. These three facts, to wit: (1) the theoretical minimum wage of the Standard Population (2) the average wage, and (3) the percentage of the wage dividend received by the less capable group, are all the facts that are necessary in order to apply at once the theory of differential wages.

We shall now proceed to determine what the distribution would be according to the theory of reward in proportion to ability and shall then compare the theoretical distribution with the actual distribution.

Since the average wage is 5.864 francs, the whole wage dividend to be shared by the Standard Population of One Hundred is 586.40 francs. As the less capable group receives 39.819 per cent of the total dividend, the first fifty members of the Standard Population will divide between them 233.50 francs, and the more capable fifty will receive $586.40 - 233.50 = 352.90$ francs. The minimum wage in the less efficient group is 2.36 francs, and since, according to the differential hypothesis each of the fifty members of this group will receive the minimum wage of the group plus a supplement proportionate to his dif-

ferential ability, the total amount to be divided among the fifty laborers in the form of supplementary payment is $233.50 - (50)\ (2.36) = 115.50$ francs. The resulting distribution in this group will therefore be computed by means of column VIII in Table II of the Appendix to this chapter. For example, the fifty-first laborer — who is the ablest member of the less capable group — will receive $2.36 + (115.50)\ (.029083) = 2.36 + 3.3591 = 5.72$ francs. In a similar manner the amounts received by the other members of this group may be computed.

The dividend of the more capable group is 352.90 francs. The minimum wage of the group is the highest wage that could be earned in the lower group, which, as we have just seen, is 5.72 francs. This method of estimating the minimum wage of the more efficient group is regarded as in harmony with actual practice where the minimum wage in a group is equal to the highest wage that could be earned in other forms of employment open to the laborer.

According to the differential hypothesis the members of the abler group receive likewise the minimum wage of their group plus a supplement proportionate to their differential ability. As the minimum wage is 5.72 francs, and the total amount shared is 352.90 francs, the amount distributed in the form of supplementary payments is $352.90 - (50)(5.72) = 66.90$ francs. This sum 66.90 francs is distributed according to Table II of the Appendix, column IV. For example, the ablest member of the Standard Popula-

tion receives as total wage $5.72 + (66.90)\ (.062670) = 5.72 + 4.1926 = 9.91$. The fiftieth laborer receives $5.72 + (66.90)\ (.000622) = 5.72 + .0416 = 5.76$ francs. The wages of the other members of the more efficient group are computed in the same way. The resulting distribution of wages in the total Standard Population may be seen in columns IV and V of Table II printed in the text.

To what degree is the differential hypothesis of wages borne out by the facts of wage receiving in the French *Département?* If the figures in Table II for the actual distribution of wages in the *Département de la Seine* and for the distribution in the Standard Population were plotted just as they are, it would be seen that the approximation is very close, but, because of the zigzag shape assumed by each series of figures, the measure of the degree of approximation would be rather vague. The result of the method which I have adopted to bring out the degree of accordance between fact and theory may be seen by referring to Figure 13. In this figure the zigzag line gives the actual percentage frequencies of wages as they appear between limits 2.36 and 10.18 in the French report. The dashed smooth curve, computed by Professor Pearson's method of moments, is the curve fitting best the actual figures. The continuous smooth curve is the best fit to the tabulated wages of the Standard Population. The fact that the smooth curve of the actual data is practically congruent with the smooth curve of the Standard Population shows

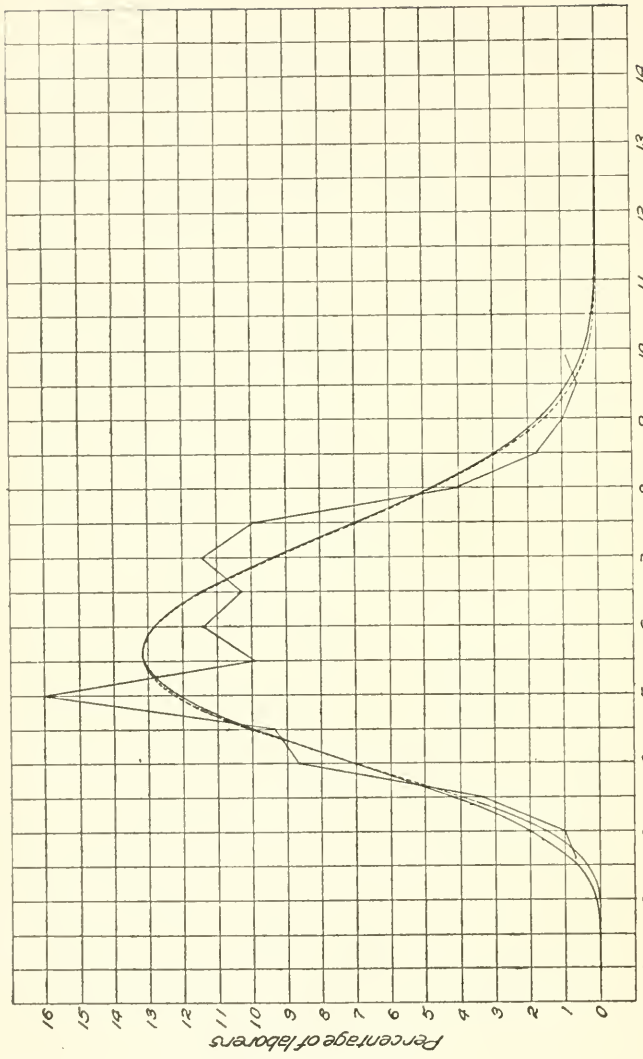

FIGURE 13. — Illustrating the distribution of wages in the *Département de la Seine* and in the Standard Population.

that in this particular case, a doctrine of pure economics is statistically verified. "La valeur relative du salaire . . . dépend essentiellement de la rareté des aptitudes intellectuelles et physiques nécessaires à l'ouvrier, du degré de développement de ces mêmes aptitudes qu'exigent les diverses professions." The words of the French report are now the accurate description of an economic law.

(*b*) Wages in Massachusetts.

As the distribution of wages in the *Département de la Seine* presents only a small degree of skewness, we shall offer a further test of the differential theory of wages by taking a case in which the distribution is characterized by a considerable degree of asymmetry. Table III of the text, which exhibits data for Massachusetts, has been constructed in a similar manner to that of Table II referring to the *Département de la Seine.* The crude data of the table were taken from the *Census of Manufactures*, 1905, Bulletin 93, p. 109. Figure 14 illustrates the degree of correspondence between theory and practice.

Remark upon the Preceding Demonstration.

The equal division of the Standard Population of One Hundred into two groups needs justification. The asymmetry of a wage curve is due to the influence of several factors, among which are the relative numbers of laborers at different ages, the increasing value of high degrees of efficiency due to the increasing con-

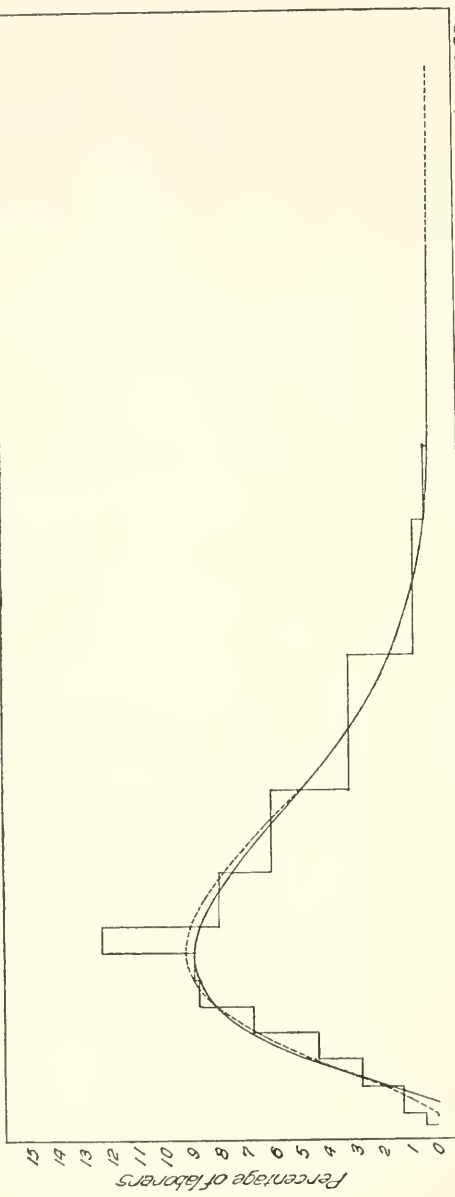

FIGURE 14.—Illustrating the distribution of wages in Massachusetts and in the Standard Population.

TABLE III. — Percentage Distribution of Laborers according to Weekly Rates of Wages in Massachusetts and in the Standard Population

Massachusetts			Standard Population	
I	II	III	IV	V
Rate in Dollars	Number	Percentage	Rate in Dollars	Number
2.79	1414	.44	2.58	1
3.50	4176	1.29	3.68	1
4.50	8920	2.75	4.50	2
5.50	13,937	4.31	5.50	4
6.50	22,104	6.83	6.50	6
7.50	28,055	8.66	7.50	9
8.50	28,425	8.78	8.50	11
9.50	39,951	12.34	9.50	13
10.50	27,084	8.36	10.50	8
11.50	24,705	7.63	11.50	7
12.50	22,239	6.87	12.50	6
13.50	19,754	6.10	13.50	6
14.50	17,216	5.32	14.50	5
15.50	14,748	4.55	15.50	5
16.50	12,603	3.89	16.50	4
17.50	9958	3.08	17.50	3
18.50	8098	2.50	18.50	2
19.50	6203	1.92	19.50	2
20.50	4541	1.40	20.50	2
21.50	3164	.98	21.64	1
22.50	2020	.62	22.81	1
23.50	1162	.36	24.92	1
24.50	1041	.32		
25.50	921	.28		
26.50	800	.25		
27.40	546	.17		
Total	323,785	100.00	Total	100

centration of industry,[1] the temporary monopoly of particular grades of skill, and the strategic advantage in bargaining enjoyed by trade-unions. It is not possible at present to determine how far these factors are respectively effective in raising wages, and the equal division of the Standard Population into two groups is simply a means of giving expression to the joint effect of a number of factors whose individual influence has not yet been determined. It would be more philosophic but less simple to assume that this "joint effect" to the advantage of efficient laborers is a linear function of their differential efficiency.

[1] See Chapter VI.

APPENDIX

Notes on the Construction of Table I.

I. The table is composed of eight columns. Columns I and V, marked p, give the rank of the individual in the total population of 100. Columns II and VI, marked $\frac{\chi_p}{s}$, give the difference between each individual and the next in order of rank divided by the standard deviation of the whole group. Columns III and VII give the difference, in terms of the standard deviation, between each individual of the group and the last member of the group. The first entry in column III is obtained by summing the entries in columns II and VI. The second entry in III is obtained by subtracting from the first entry in that column the first entry in column II. Similarly of the remaining entries in columns III and VII. Columns IV and VIII are obtained by expressing each entry in columns III and VII as a percentage of the sum of the entries in columns III and VII. For example, the total of columns III and VII is 251.4425, and the first item in column III, 5.02885, is .02 of 251.4425.

II. The mathematical derivation of $\frac{\chi_p}{s}$ is explained in the "Notes on the Construction of Table II."

TABLE I. — Average Differential Ability in a Population of One Hundred

I	II	III	IV	V	VI	VII	VIII
p	Difference $\frac{\chi_p}{s}$	Difference from the 100th Person	Percentage of 251.442500	p	Difference $\frac{\chi_p}{s}$	Difference from the 100th Person	Percentage of 251.442500
1	.360964	5.028850	.020000	51	.025074	2.501892	.009950
2	.200664	4.667886	.018564	52	.025098	2.476818	.009850
3	.144746	4.467222	.017766	53	.025137	2.451720	.009751
4	.114680	4.322476	.017191	54	.025192	2.426583	.009651
5	.095994	4.207796	.016735	55	.025266	2.401391	.009550
6	.083843	4.111802	.016353	56	.025354	2.376125	.009450
7	.074499	4.027959	.016019	57	.025458	2.350771	.009349
8	.067258	3.953460	.015723	58	.025583	2.325313	.009248
9	.061599	3.886202	.015456	59	.025732	2.299730	.009146
10	.056909	3.824603	.015211	60	.025881	2.273998	.009044
11	.053146	3.767694	.014984	61	.026061	2.248117	.008941
12	.049990	3.714548	.014773	62	.026260	2.222056	.008837
13	.047250	3.664558	.014574	63	.026486	2.195796	.008733
14	.044913	3.617308	.014386	64	.026725	2.169310	.008627
15	.042871	3.572395	.014208	65	.026994	2.142585	.008521
16	.041081	3.529524	.014037	66	.027287	2.115591	.008414
17	.039512	3.488443	.013874	67	.027614	2.088304	.008305
18	.038131	3.448931	.013716	68	.027967	2.060690	.008195
19	.036854	3.410800	.013565	69	.028347	2.032723	.008084
20	.035700	3.373946	.013418	70	.028755	2.004376	.007971
21	.034686	3.338246	.013276	71	.029207	1.975621	.007857

22	.033769	3.303560	.013138	72	.029710	1.946414	.007741
23	.032937	3.269791	.013001	73	.030247	1.916704	.007623
24	.032160	3.236851	.012873	74	.030822	1.886457	.007502
25	.031479	3.204694	.012745	75	.031479	1.855635	.007380
26	.030822	3.173215	.012620	76	.032160	1.824156	.007255
27	.030247	3.142393	.012497	77	.032937	1.791996	.007127
28	.029710	3.112146	.012377	78	.033769	1.759059	.006996
29	.029207	3.082436	.012259	79	.034686	1.725290	.006861
30	.028755	3.053229	.012143	80	.035700	1.690604	.006724
31	.028317	3.024174	.012028	81	.036854	1.654904	.006582
32	.027967	2.996127	.011916	82	.038131	1.618050	.006435
33	.027614	2.968160	.011804	83	.039512	1.579919	.006283
34	.027287	2.940546	.011695	84	.041081	1.540407	.006126
35	.026991	2.913259	.011586	85	.042871	1.499326	.005963
36	.026725	2.886265	.011479	86	.044913	1.456455	.005792
37	.026486	2.859540	.011372	87	.047250	1.411542	.005614
38	.026260	2.833051	.011267	88	.049990	1.364292	.005426
39	.026061	2.806794	.011163	89	.053146	1.314302	.005227
40	.025881	2.780733	.011059	90	.056909	1.261156	.005016
41	.025732	2.754852	.010956	91	.061599	1.204247	.004789
42	·025583	2.729120	.010854	92	.067258	1.142648	.004544
43	.025458	2.703537	.010752	93	.074499	1.075390	.004277
44	.025354	2.678079	.010651	94	.083843	1.000891	.003980
45	.025266	2 652725	.010550	95	.095991	.917048	.003647
46	.025192	2.627459	.010449	96	.114680	.821054	.003265
47	.025137	2.602267	.010349	97	.144746	.706374	.002809
48	.025098	2.577130	.010249	98	.200614	.561628	.002234
49	.025074	2.552032	.010149	99	.360964	.360964	.001436
50	.025066	2.526958	.010050				
				Total	5.028850	251.142500	

Notes on the Construction of Table II.

I. The table is composed of eight columns. Columns I and V, marked p, give the rank of the individual in the total population of 100. Columns II and VI, marked $\frac{\chi_p}{s}$, give the difference between each individual and the next in order of rank, divided by the standard deviation of the whole group. Column III gives the difference, in terms of the standard deviation, between each of the first fifty members of the group and the fifty-first member. The first entry in the column is obtained by summing the entries in column II. The second entry in column III is obtained by subtracting from the first entry in that column the first entry in column II. Similarly of the remaining entries in column III. Column VII is constructed from column VI in the same way that column III is constructed from column II. Column IV is obtained by expressing each entry in column III as a percentage of the sum of the entries in column III. Similarly column VIII is constructed from column VII. For example, the total of column III is 40.321478, and the first item in column III, 2.526958, is .06267 of 40.321478.

II. In computing the successive differences between the first six members of the Standard Population, Professor Pearson's formula for χ_p was used.

$$\chi_p = s\,\frac{\sqrt{2\pi p}\,p^p e^{-p}}{\lfloor p}\,\frac{1}{ny_m}\{1 + c_1 + c_2 + c_3 \cdots\},$$

where s is the standard deviation. (See *Biometrika*, Vol. I, p. 396, formula XXVII.)

III. Since, by Stirling's formula, when p is large, $\lfloor p = \sqrt{2\pi p}\,p^p e^{-p}$, the factor $\frac{\sqrt{2\pi p}\,p^p e^{-p}}{\lfloor p}$, in the above for-

mula for χ_p, approximates to unity with increasing values of p. The last factor, $\{1 + c_1 + c_2 + c_3 \cdots\}$, seems also to approach unity as p increases. When $p = 5$,

$$\frac{\sqrt{2\pi p}\, p^p e^{-p}}{\lfloor p} \{1 + c_1 + c_2 + c_3 \cdots\} = .989794.$$

It has consequently been thought sufficient for the purposes of this chapter to compute χ_p by the formula $\chi_p = \frac{s}{n y_m}$ for the values of p greater than 5 and less than 51.

IV. The values of m, which were needed to obtain y_m, were computed from the formula $\frac{n-2p}{n} = \sqrt{\frac{2}{\pi}} \int_0^m e^{-\frac{1}{2}x^2} dx$. (*Ibid.*, p. 395, formula XII.) In making these computations the values of the probability integral as given in *Merriman's Least Squares* were used. The table was computed several years ago when I was not acquainted with the apparatus for making easy and accurate calculations. The values of m and y_m could be obtained simultaneously from Sheppard's Tables (*Biometrika*, Vol. II, pp. 174–190), by using the formulæ

$$\frac{n-p}{n} = \int_{-\infty}^{+m} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2} dx, \text{ and } y_m = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}m^2}.$$

(*Biometrika*, Vol. I, p. 395.)

V. The degree of accuracy of the table is not so great as it appears to be because, in the evaluation of m, Barlow's tables were employed in the calculation of squares, and consequently only four figures were used. This defect does not in any degree invalidate the theoretical result that has been reached, but it is noted here as a warning to others who, otherwise, might use the table for a purpose requiring greater precision. That it is practi-

cally accurate for present purposes follows from the fact noted in the chapter that when the distribution of wages is calculated by Table I the resulting smooth graph is a Gaussian curve. The degree of fit, when subjected to the Pearsonian test, gives $n' = 17$ and $\chi^2 = .942782$, which is practically a perfect fit.

TABLE II — Standard Population of One Hundred

I	II	III	IV	V	VI	VII	VIII
p	Difference $\frac{\chi p}{s}$	Difference from the 51st Person	Percentage of 40.321478	p	Difference $\frac{\chi p}{s}$	Difference from the 100th Person	Percentage of 86.026422
1	.360964	2.526958	.062670	51	.025074	2.501892	.029083
2	.200664	2.165994	.053718	52	.025098	2.476818	.028791
3	.144746	1.965330	.048741	53	.025137	2.451720	.028500
4	.114680	1.820584	.045152	54	.025192	2.426583	.028207
5	.095994	1.705904	.042308	55	.025266	2.401391	.027915
6	.083843	1.609910	.039927	56	.025354	2.376125	.027621
7	.074499	1.526067	.037847	57	.025458	2.350771	.027326
8	.067258	1.451568	.036000	58	.025583	2.325313	.027030
9	.061599	1.384310	.034332	59	.025732	2.299730	.026733
10	.056909	1.322711	.032804	60	.025881	2.273998	.026434
11	.053146	1.265802	.031393	61	.026061	2.248117	.026133
12	.049990	1.212656	.030075	62	.026260	2.222056	.025830
13	.047250	1.162666	.028835	63	.026486	2.195796	.025525
14	.044913	1.115416	.027663	64	.026725	2.169310	.025217
15	.042871	1.070503	.026549	65	.026994	2.142585	.024906
16	.041081	1.027632	.025486	66	.027287	2.115591	.024592
17	.039512	.986551	.024467	67	.027614	2.088304	.024275
18	.038131	.947039	.023487	68	.027967	2.060690	.023954
19	.036854	.908908	.022542	69	.028347	2.032723	.023629
20	.035700	.872054	.021628	70	.028755	2.004376	.023300
21	.034686	.836354	.020742	71	.029207	1.975621	.022965
22	.033769	.801668	.019882	72	.029710	1.946414	.022626
23	.032937	.767899	.019044	73	.030247	1.916704	.022280
24	.032160	.734962	.018228	74	.030822	1.886457	.021929
25	.031479	.702802	.017430	75	.031479	1.855635	.021571
26	.030822	.671323	.016649	76	.032160	1.824156	.021205
27	.030247	.640501	.015885	77	.032937	1.791996	.020831
28	.029710	.610254	.015135	78	.033769	1.759059	.020448
29	.029207	.580544	.014398	79	.034686	1.725290	.020055
30	.028755	.551337	.013674	80	.035700	1.690604	.019652
31	.028347	.522582	.012960	81	.036854	1.654904	.019237
32	.027967	.494235	.012257	82	.038131	1.618050	.018809
33	.027614	.466268	.011564	83	.039512	1.579919	.018366
34	.027287	.438654	.010879	84	.041081	1.540407	.017906
35	.026994	.411367	.010202	85	.042871	1.499326	.017429
36	.026725	.384373	.009533	86	.044913	1.456455	.016928
37	.026486	.357648	.008870	87	.047250	1.411542	.016408
38	.026260	.331162	.008213	88	.049990	1.364292	.015859
39	.026061	.304902	.007562	89	.053146	1.314302	.015278
40	.025881	.278841	.006915	90	.056909	1.261156	.014660
41	.025732	.252960	.006274	91	.061599	1.204247	.013999
42	.025583	.227228	.005635	92	.067258	1.142648	.013283
43	.025458	.201645	.005001	93	.074499	1.075390	.012501
44	.025354	.176187	.004370	94	.083843	1.000891	.011635
45	.025266	.150833	.003741	95	.095994	.917048	.010660
46	.025192	.125567	.003114	96	.114680	.821054	.009544
47	.025137	.100375	.002489	97	.144746	.706374	.008211
48	.025098	.075238	.001866	98	.200644	.561628	.006529
49	.025074	.050140	.001244	99	.360964	.360964	.004196
50	.025066	.025066	.000622				
Total	2.526958	40.321478	—	Total	2.501892	86.026422	—

CHAPTER V

WAGES AND STRIKES

"Ce ne sont pas les grèves qui rendent compte des variations du salaire, soit par leur succès, soit par leur échec, mais ce sont les causes réelles de variation du salaire qui se manifestent par une part dans les grèves et rendent compte de l'existence, de la place et des résultats de ces grèves mêmes."

— François Simiand.

In the investigation of the critical question of modern industry concerning the relation of wages to strikes, neither of the extreme theories as to the nature of that relation will be adopted as an exclusive working hypothesis. The wage-fund theorists will not be followed in their assumption that the rate of wages is determined by inexorable economic laws, and that organizations of laborers for the purpose of increasing wages must at best be ineffectual, while as a rule they would prove harmful. Nor will the militant syndicalist be followed in the assumption of an unlimited power of labor organizations to better the economic status of the laborer. The one hypothesis that is entertained is that both economic law and trade combinations affect the outcome of trade disputes as to wages, and the scientific task that is imposed is to measure, as far as possible with available data, the relative importance of the two factors in the determination of the resulting rate of wages.

Preceding chapters have shown, not theoretically but concretely, that wages move *pari passu* with the productivity of labor, and that the productivity of labor is conditioned by the degree and nature of the organization of capital and labor in industry. Does the productivity of labor likewise set bounds to the power of labor organizations to raise wages? Does the productivity theory of wages give a clew to regularities in the outcome of strikes? Are there economic laws of strikes?

In this chapter an attempt will be made to obtain some definite idea as to the power of trades-unions to raise wages and as to the limits set by economic law to the effective activity of trades-unions. The inquiry will consequently seek answers to two questions: (1) as to the manner and measure in which trades-unions influence the outcome of trade disputes; and (2) as to the manner and measure in which the outcome of trade disputes is limited by economic law.

Outcome of Strikes as affected by Trades-Unions.

If it be true that labor organizations exert an influence on the outcome of strikes, then the following conclusions would seem to be necessary corollaries: (1) The outcome of strikes that are declared by labor organizations should be more favorable to the interests of laborers than the outcome of strikes that are not so declared; (2) The stronger the labor organization in an industry, the more favorable to the interests of

the laborer should be the outcome of strikes that are declared by labor organizations in the industry. These two conclusions we shall test with the available data.

The material used in the treatment of most of the topics discussed in this chapter may be found in the volume on *Strikes and Lockouts* that was issued, in 1906, as the Twenty-First Annual Report of the Commissioners of Labor, for the United States. This volume will be referred to, simply, as the Report.

TABLE I. — Correlation between the Outcome of Strikes and the Ordering or not Ordering of Strikes by Labor Organizations

	Outcome of Strikes Establishments in which Strikes			Total
	Succeeded	Succeeded Partly	Failed	
Ordered by Labor Organizations	80,772	25,916	56,563	163,251
Not ordered by Labor Organizations	5927	1720	9857	17,504
Total	86,699	27,636	66,420	180,755

Table I of the present chapter, which was compiled from pages 490–491 of the Report, presents material pertinent to an investigation as to whether the results of strikes ordered by labor organizations are more favorable to the interests of laborers than the results

of strikes that are not so ordered. The table gives a summary of the results of strikes in the United States from 1881 to 1905.

The method that is employed to measure the relation between the two variables — the outcome of strikes and the ordering or not ordering of strikes by labor unions — is the method that has recently been invented by Professor Pearson[1] for the evaluation of the "correlation ratio," which is symbolized by the Greek letter η. The method is applicable to problems like the one presented in Table I, on condition that one of the variables may be assumed to be distributed according to the Gaussian law. The method affords a good first approximate measure of relation when the distribution of the variable is slightly skew. The arithmetical value of η, like the coefficient of correlation, varies from zero to unity.

In making the computation in the particular case of Table I, it has been assumed that the alternative variable — "ordered by labor organizations" and "not ordered by labor organizations" — is distributed according to the normal law. Some justification of the assumption is found in the definition of the terms by the Bureau of Labor. "The number of strikes ordered by labor organizations includes all strikes ordered by direct vote of a labor organization and also all ordered by a business agent or

[1] *Biometrika*, Vol. VII, pp. 248-257. "On a New Method of determining Correlation when One Variable is given by Alternative and the Other by Multiple Categories."

committee of such organization acting under powers conferred by the organization." Report, p. 109. "The strikes that are tabulated as not having been ordered by labor organizations are not necessarily strikes begun and carried on by employees who were not members of an organization. They include not only this class of strikes, but also strikes carried on by members of organizations, when these strikes were without the authority of such organizations." Report, p. 31.

The value of η computed on the assumption that the alternative variable is normal in its distribution is .218. The conclusion is therefore justified that the results of strikes ordered by labor organizations are more favorable to the interests of laborers than the results of strikes that are not ordered by labor organizations. The degree of association between the two variables is, however, rather low, and is measured by $\eta = .218$.

The second inquiry concerning the influence exerted by labor organizations on the outcome of strikes may be worded as follows: To what degree is it true that the stronger the labor organizations in an industry, the more favorable to the interests of the laborers are the results of strikes that are declared by labor organizations in the industry? In order to obtain an answer to this question, it will be necessary to agree upon some measure of strength in labor organizations, and to array the various

industries of the country in the order in which labor organizations are strong, in respect to the quality of strength that is agreed upon.

From one point of view, the strength of labor unions may be measured by the degree in which the trade disputes in an industry are ordered by trades-unions. If a large proportion of the strikes in an industry have their origin outside of the trades-unions, it may be assumed, as a general rule, not only that trades-unions are not strong when the industry is considered as a whole, but that the unions in the organized part of the industry are not strong. The fighting capacity of the organized part of the industry must be weakened, as a general rule, by the existence of a large body of unorganized laborers in kindred occupations of the same industry.

When the strength of trades-unions is measured by the degree in which the strikes in an industry are ordered by trades-unions, is there any relation between the strength of the unions and the outcome of strikes ordered by the unions?

On pages 33–34 of the Report on *Strikes and Lockouts* a table is given of "Strikes and Establishments involved in Strikes ordered by Labor Organizations and not so ordered, by Industries, 1881 to 1905." This table supplies material for ranking the 82 enumerated industries according to the percentages of total strikes, in the several industries, that were ordered by labor organizations. For example, in the industry for the manufacture of agricultural

implements, labor organizations declared 63.22 per cent of all the strikes affecting that industry between the years 1881 and 1905 inclusively. It is assumed in the subsequent argument (1) that the control of trade disputes of an industry on the part of labor unions is proportional to the percentage of total strikes affecting the industry that are declared by labor unions; (2) that the strength of the labor organizations of a particular industry is proportional to their control of trade disputes.

On pages 486–487 of the same Report there is given a table headed, "Summary of Strikes for the United States, ordered by Labor Organizations and not so ordered, by Industries, 1881 to 1905." The same 82 industries that appeared in the table which has just been described are enumerated also in the above "Summary." Furthermore, this "Summary" gives the outcome of strikes that were ordered by labor organizations, according as the strikes succeeded, succeeded partly, or failed.

From these official data Table II has been constructed. The table will afford the means of measuring the relation between the degree in which labor unions control trade disputes and the outcome of strikes ordered by unions. That is to say, the table will supply an answer to the question as to whether the outcome of a strike ordered by labor organizations is in any way associated with the measure in which the labor organizations control the trade disputes of the industry. If the hypothesis is accepted

TABLE II. — Contingency between the Strength of Labor Organizations and the Outcome of Strikes ordered by Labor Organizations

Outcome of Strikes ordered by Labor Organizations: Establishments in which Strikes	Percentage of Total Strikes that were ordered by Labor Organizations								Total	Chances
	Below 20	20–30	30–40	40–50	50–60	60–70	70–80	Above 80		
Failed	211 (133.05)	376 (319.10)	993 (538)	905 (964.84)	11622 (7894.49)	713 (597.17)	8345 (6908.79)	30347 (36156.57)	53512	.3420193
Succeeded Partly	67 (62.02)	136 (148.74)	214 (250.77)	749 (449.73)	6037 (3679.78)	503 (278.35)	2463 (3220.32)	14774 (16853.29)	24943	.1594220
Succeeded	111 (193.94)	421 (465.16)	366 (784.23)	1167 (1406.43)	5423 (11507.73)	530 (870.48)	9392 (10070.89)	60594 (52705.14)	78004	.4985587
Total	389	933	1573	2821	23082	1746	20200	105715	156459	1.0000000

that the strength of labor organizations is proportional to their control of trade disputes, Table II will likewise supply an answer to the question as to whether the strength of labor organizations has anything to do with the outcome of strikes declared by organizations.

The construction of the table will be made clear by an illustration. In the first column of the body of the table marked "Below 20," the figures 389 signify that, in all of the industries covered by the official report, 389 establishments in which strikes occurred were in industries in which labor organizations declared below 20 per cent of the total strikes of the industry. In case of 211 of these 389 establishments the strikes failed; in 67 of the establishments the strikes were compromised; and in 111 of the establishments the strikes succeeded. It will be observed that the table refers only to the outcome of strikes ordered by labor organizations. All of the data in the official summary have been included except the material referring to "domestic service" and to "miscellaneous."

From this table two conclusions will be drawn: (1) as to the nature of the association between the outcome of strikes and the degree of control of trade disputes on the part of labor organizations, and (2) as to the measure of this relation.

The method employed in extracting the conclusions from the data is the method invented by Professor Pearson for the derivation of the coefficient of mean

square contingency. An indication of the significance of the coefficient of mean square contingency, as a measure of association, is given by the following consideration: The total number of establishments in which strikes occurred is seen, from the entry in the next to the last column and the bottom row, to have been 156,459. Of this total number of establishments 53,512 were establishments in which the strikes failed; 24,943 were establishments in which the strikes succeeded partly; and 78,004 were establishments in which the strikes succeeded. The last column marked "Chances" gives the ratio of these numbers, respectively, to the total number 156,459. If, now, the outcome of the strikes in the 389 establishments recorded in the first column had been similar to the outcome in the whole of the establishments enumerated, the number of the establishments in which the strikes failed would have been $(389)(.3420193) = 133.05$; the number in which strikes succeeded partly would have been $(389)(.159422) = 62.02$; and the number in which strikes succeeded would have been $(389)(.4985587) = 193.94$. Numbers derived in this way will be referred to as the numbers given by independent probability.

Now it is clear that the numbers actually occurring in the subgroups differ from those given by independent probability. In case of the establishments in which strikes failed, we have in the first column $211 - 133.05 = +77.95$. And in case of the establishments in which strikes were successful, we have

111 − 193.94 = − 82.94. That is to say, in industries in which labor organizations were weakest, — in the sense of controlling only a small percentage of the strikes that occurred in the industries, — the outcome of strikes, in establishments in which strikes occurred, was such that there was a positive deviation from independent probability of +77.95 in case of strikes that failed ; while, in case of strikes that succeeded, there was a negative deviation from independent probability equal to − 82.94.

If, in a similar manner, the column marked " Above 80 " is examined, it will be found that, in case of establishments in which strikes failed, there is a negative deviation equal to − 5809.57, while, in establishments in which strikes succeeded, there is a positive deviation equal to 7888.86.

We find, therefore, that for weakly organized industries, the successes are fewer and the failures are more than would be given by independent probability ; while for strongly organized industries the contrary relation proves to be true. These two extreme columns suggest that the outcome of a strike is in some manner related to the degree of union control of the industry, and it is required to determine rigidly from all of the data of the table the quality and the degree of association between the two variables.

The deviations from the independent probability of the same sign, or some function of the deviations may be taken as a measure of the association. But, as in other forms of relation the coefficient of correlation

has been used to measure the degree of association, it is desirable — in order that types of association like that with which we are dealing may be compared with types in which the coefficient of correlation is the appropriate measure of association — to choose from the many possible functions of deviations from independent probability such a function that, in case of normal distribution where the two methods may be applied, the measure of association remains the same, whether it is computed by the newer method or by the method of the coefficient of correlation. The coefficient of mean square contingency, which is a function of the squares of the deviations from independent probability, and the coefficient of mean contingency, which is a function of the deviations of the same sign, are two functions that fulfill the above conditions. If the former coefficient be represented by C_1 and the latter by C_2, then, in case of normal distribution when all three methods may be applied, $C_1 = C_2 = r$, where r is the coefficient of correlation. The range of value of C_1 and C_2 is from zero to unity. Their signs must be determined by special methods.[1]

When the association or contingency between the degree of union control of strikes and the outcome of strikes is computed from our Table II by means of the contingency coefficients, we obtain for the coefficient of mean square contingency $C_1 = .232$; and for the coefficient of contingency $C_2 = .30$.

[1] Karl Pearson: *On The Theory of Contingency and its Relation to Association and Normal Correlation.*

The conclusions from the investigation are, therefore: (1) The greater the degree in which labor organizations control the disputes of an industry, the more likely is the outcome of a strike declared by labor organizations to be favorable to the interests of laborers; (2) The measure of the association between the degree in which labor unions control trade disputes and the outcome of strikes declared by organizations is $C_1 = .232$ and $C_2 = .30$.

Figure 15 illustrates the association between the two variables. The diagram is constructed on the assumption that the variable which measures the outcome of strikes is distributed according to the normal law.[1] The origin is taken at a line separating establishments in which strikes "succeeded partly" from establishments in which strikes "failed." The zigzag line is the line of the means of the respective categories. It is seen that the mean outcome of strikes, in industries in which below 20 per cent of the strikes were called by labor organizations, was a failure; while in industries in which above 80 per cent of the strikes were called by labor organizations, the mean outcome of strikes was a success. As the degree of control of trade disputes by labor organizations increases, the general trend of the mean outcome of strikes moves from failure, through compromise, to success.

There is need of great caution in the interpretation

[1] Let it be observed that no point in the argument is dependent upon this assumption. This form of diagram was invented, I believe, by Professor Pearson.

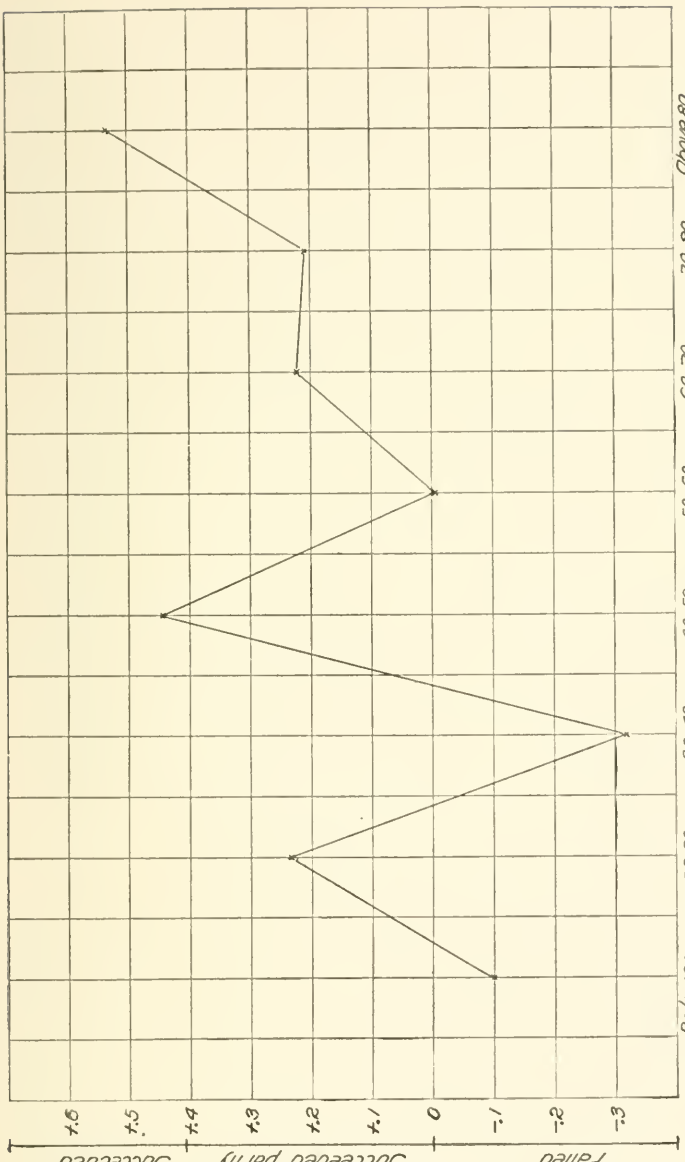

FIGURE 15. — Illustrating the relation of the strength of Labor Organizations to the outcome of strikes ordered by Labor Organizations.

of these results. It is not to be inferred that the relation between the strength of labor unions and the outcome of strikes is a relation of cause and effect. The low value of C_1 precludes the hypothesis of a direct cause and effect relation. The two phenomena may be joint effects of a common cause. Moreover, the results have been determined from data as to all industries and as to all causes. The mixing of the material in this manner introduces an element into the problem the influence of which it would be difficult to measure. Suppose that the outcome of strikes is dependent upon the nature of the particular causes for which the strikes are called, that is to say, suppose that the probabilities of the outcome of strikes being in favor of the laborers vary according to the nature of the causes. Then, if labor organizations in weakly organized industries are predisposed to strike for causes that are likely to fail, while the stronger unions enter into trade disputes for more promising causes, the results that we have obtained would find their explanation not in the degree in which labor unions control trade disputes, but in the wisdom with which strong unions choose the grounds of the disputes into which they enter.

Before taking up these considerations, we may note another relation that has a bearing upon the outcome of strikes, as far as the outcome is affected by the strength of labor organizations. Is the result of a strike the more likely to be favorable to the interest of the laborers, the greater the length of time the

laborers hold out? Or is the contrary the case? If the duration of a strike and its outcome are either directly or inversely related, what is the measure of the degree of association between the two?

TABLE III. — Contingency between the Duration of Strikes and the Outcome of Strikes. Germany, 1899–1905

		Days of Duration							Total
		1–5	6–10	11–20	21–30	31–50	51–100	101 or over	
Number of Strikes that	Succeeded	1134	353	275	122	80	57	14	2035
	Succeeded partly	1106	601	577	364	336	299	124	3407
	Failed	1563	598	517	344	434	438	181	4075
Total		3803	1552	1369	830	850	794	319	9517

TABLE IV. — Contingency between the Duration of Strikes and the Outcome of Strikes. France 1890–1905

		Days of Duration					Total
		7 or under	8–15	16–30	31–100	101 or over	
Number of Strikes that	Succeeded	1522	285	132	98	4	2041
	Succeeded partly	1665	618	379	328	36	3026
	Failed	2131	613	337	337	51	3469
Total		5318	1516	848	763	91	8536

Tables[1] III and IV, referring respectively to the history of strikes in Germany from 1899 to 1905, and to the history of strikes in France from 1890 to 1905, supply material for answering these questions. In case of the figures for Germany $C_1 = .22$; $C_2 = .26$. In case of the figures for France, $C_1 = .16$; $C_2 = .19$.

It may be concluded that —

(1) the greater the duration of the strike, the less likely is the outcome of the strike to be favorable to the interests of the laborers;

(2) the measure of the association between the duration of strikes and the outcome of strikes is, in case of Germany, $C_1 = .22$; in case of France, $C_1 = .16$.

Here again caution in the interpretation of the results is very necessary. Is it to be inferred from the above conclusions that protracted strikes tend to end contrary to the interests of laborers because the greater duration of the struggle exhausts the funds of trades-unions and weakens their fighting capacity? The inference is not warranted by the data. The low coefficients of contingency suggest the unwisdom of drawing any conclusion from the data as to cause and effect. Besides, the lumping of the results of all causes of strikes leaves room for an indefinite number of hypotheses as to the specific cause of the relation that has been established. May it not be true that

[1] The tables are taken from the Report for 1906 on *Strikes and Lockouts*, pp. 859, 840.

strong unions, when they do enter into trade disputes, strike for causes that are likely to end quickly in the interests of the laborers, while the weaker unions vainly protract their disputes through ignoring economic laws in the choice of the time and grounds of their strikes?

Outcome of Strikes as Limited by Economic Law.

This discussion brings us to the consideration of the rôle of economic law in determining the outcome of strikes. In searching for the influence of economic laws in this particular field the first question that one is led to ask takes this form: Is the outcome of a strike, so far as the interests of the laborers are concerned, independent of the nature of the cause of the strike? This question may be put more concretely. The Bureau of Labor of the United States classifies strikes according as they had their origin in one or more of fourteen causes. Is it found, from the record of the Bureau, that strikes succeed, succeed partly, or fail in the same proportion of cases, no matter what the cause of the strikes may be? Or is it true that certain causes of strikes are more likely to lead to successful issues than other causes? The answering of these questions will put one in the way of connecting the outcome of strikes with economic causes.

Table V, which was compiled from the Report on *Strikes and Lockouts*, p. 63, makes possible the computation of the contingency between the causes

TABLE V.—Contingency between the Causes of Strikes and the Outcome of Strikes

Outcome of Strikes: Establishments in which Strikes	Causes of Strikes: For Increase of Wages	Against Reduction of Wages	For Reduction of Hours	Against Increase of Hours	Concerning Recognition of Union and Union Rules	Concerning Employment of Certain Persons	Concerning Working Conditions and Rules	In Sympathy with Strikers Elsewhere	Total
Succeeded	30,142	3669	8775	409	10,307	1027	1286	1315	56,930
Succeeded partly	11,277	1337	1745	105	305	68	123	177	15,137
Failed	18,922	5492	6790	303	7966	3044	1680	4866	49,063
Total	60,341	10,198	17,310	817	18,578	4139	3089	6358	121,130

of strikes and the outcome of strikes. The table includes the results only of strikes that were undertaken for single causes; it does not deal with the results of strikes in which the causes were mixed.

The computation of the contingency coefficients gives $C_1 = .298$; $C_2 = .33$. With these values definitely ascertained, it cannot be denied that the outcome of a strike is associated with the kind of cause for which the strike is undertaken.

From Table V, it is also possible to derive values that will throw light upon the ranking of causes according as they are the origin of strikes that are likely to succeed, to succeed partly, or to fail. If the percentage deviations of the actual figures in the subcontingency groups are computed from independent probability, then the magnitudes and signs of the percentages will supply indices of the rank of the causes. For example, in case of the group in the upper left-hand corner, the actual frequency is 30.142, the theoretical frequency given by independent probability is 28.360; the relative deviation is therefore $\frac{30142 - 28360}{28360} = +.0628$. For the subgroup in the upper right-hand corner the relative deviation is $\frac{1315 - 2988}{2988} = -.5599$. In the first case, that is to say, in case of strikes for an increase of wages, there is a positive deviation of the successful strikes equal to 6.28 per cent, while in case of sympathetic strikes, there is a negative deviation of 55.99 per cent.

TABLE VI. — The Rank of Causes of Strikes according as Strikes undertaken for the Particular Causes deviated, in their Outcome, from Independent Probability

Succeeded	Succeeded Partly	Failed
(1) Concerning recognition of the union and union rules.	(1) For increase of wages.	(1) In sympathy with strikers elsewhere.
(2) For reduction of hours.	(2) Against increase of hours.	(2) Concerning employment of certain persons.
(3) Against increase of hours.	(3) Against reduction of wages.	(3) Concerning working rules and conditions.
(4) For increase of wages.	(4) For reduction of hours.	(4) Against reduction of wages.
(5) Concerning working conditions and rules.	(5) Concerning working conditions and rules.	(5) Concerning recognition of union and union rules.
(6) Against reduction of wages.	(6) In sympathy with strikers elsewhere.	(6) For reduction of hours.
(7) Concerning employment of certain persons.	(7) Concerning employment of certain persons.	(7) Against increase of hours.
(8) In sympathy with strikers elsewhere.	(8) Concerning recognition of union and union rules.	(8) For increase of wages.

In Table VI, the causes of strikes are ranked according as strikes undertaken for the particular causes deviate, in their outcome, from independent probability. It is found, for instance, that a strike for the recognition of the union has been the most likely to succeed; a strike for an increase of wages has been the most likely to be compromised; and a strike in sympathy with workers elsewhere has

been the most likely to fail. The other causes rank in the order of their sequence in the table.

An examination of Table V also discloses that, during the period covered by the Report, the most important causes of strikes were "For an increase of wages" and "Concerning recognition of the union and union rules." These two causes of strikes, to which were due more than 50 per cent of all the strikes that occurred between 1881 and 1905, will be subjected to further treatment.

TABLE VII.—Percentages of Total Strikes that were called, respectively, for an Increase of Wages and for the Recognition of the Union and Union Rules

Year	For an Increase of Wages	Concerning the Recognition of the Union and Union Rules	Year	For an Increase of Wages	Concerning the Recognition of the Union and Union Rules
1881	61.15	5.73	1894	30.54	12.45
1882	54.41	5.95	1895	41.98	12.35
1883	45.40	7.53	1896	26.80	21.93
1884	29.57	6.77	1897	35.81	12.99
1885	37.52	7.44	1898	36.36	15.72
1886	41.69	8.73	1899	38.84	19.53
1887	33.64	15.60	1900	32.94	15.35
1888	25.94	13.69	1901	29.04	27.98
1889	29.95	12.65	1902	32.86	25.27
1890	31.48	12.88	1903	31.57	23.24
1891	26.67	14.27	1904	23.19	32.42
1892	29.12	15.25	1905	28.07	30.86
1893	24.21	13.72			

Table VII, which was taken from the volume on *Strikes and Lockouts*, 1906, p. 56, gives the percentages of total strikes that were undertaken for

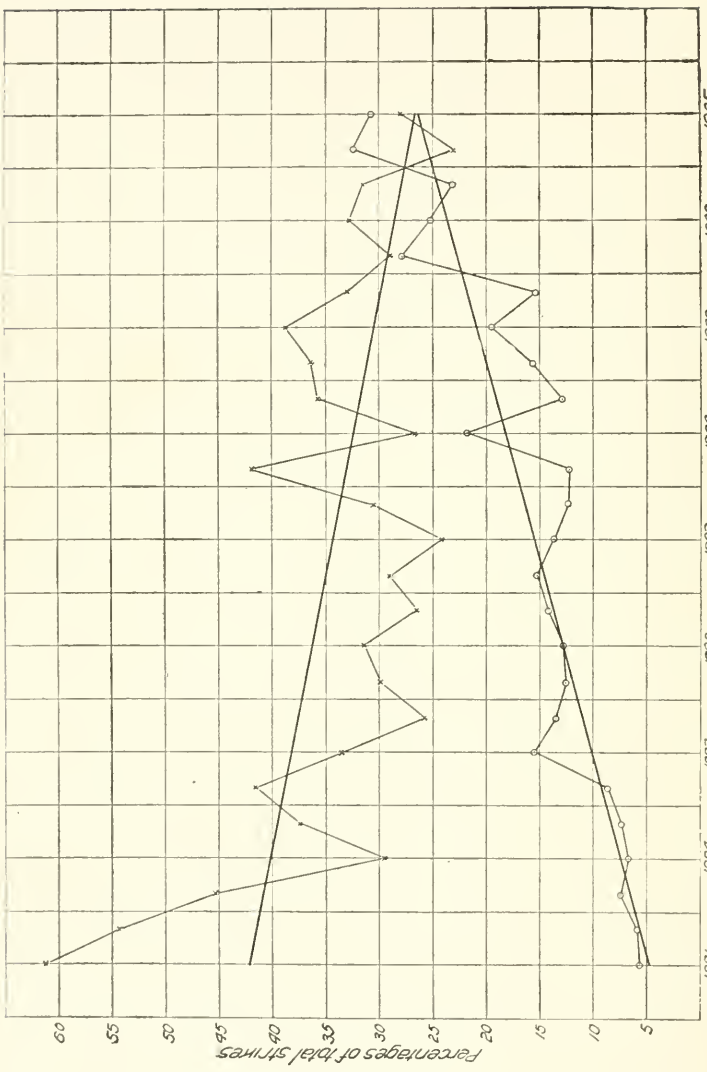

FIGURE 16. — Illustrating the general trend of the percentages of total strikes (1) for an increase of wages, ×—×; (2) for a recognition of the union, ○—○.

these two causes between the years 1881–1905, inclusively. When these figures are plotted, as in Figure 16, it is observed that the general trend of the percentage of strikes undertaken for an increase of wages has been downward, while the general trend of the percentage of strikes for a recognition of the union rules has been upward. Furthermore, there is an inverse correlation between the deviations in the two cases, that is to say, when the percentage of strikes for an increase of wages rises above the general trend, the percentage of strikes for a recognition of the union tends to fall below the general trend and *vice versa*. The coefficient of correlation between these deviations from the general trend is[1] $r = -.228$.

An additional light upon this very same question of the relation of these two causes is afforded by Table VIII, which is taken from the same Report on *Strikes and Lockouts*, p. 622. The table gives the percentages of total strikes that were successful when the causes of the strikes were, respectively, for an increase of wages and for a recognition of the union. The general trend — Figure 17 — of the percentages of total strikes that were successful was downward, in case of strikes for an increase of wages,

[1] No argument is dependent upon the absolute value of this coefficient. It contains a spurious element.

The equation to the general trend, for the percentages of total strikes that were called for an increase of wages, is $y = 31.43 - .6466\,x$; and for the percentages called for a recognition of the union, $y = 15.57 + .8967\,x$, the origin in both cases being in the middle of the year 1893.

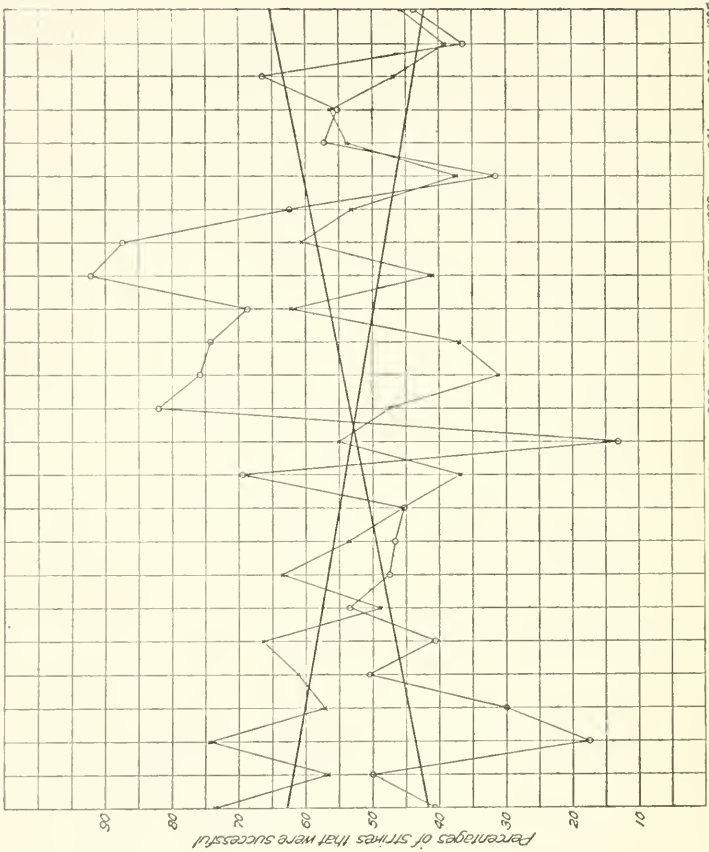

FIGURE 17.—Illustrating the general trend of the successful strikes (1) for an increase in wages, x—x; (2) for a recognition of the union, o—o.

and upward, in case of strikes for a recognition of the union. Moreover, the percentage deviations from the general trend[1] in case of successful strikes for the recognition of the union were inversely correlated with the percentage deviations from the general trend in case of successful strikes for an increase of wages. The coefficient of correlation is $r = -.207$.

TABLE VIII. — PERCENTAGE OF STRIKES THAT WERE SUCCESSFUL WHEN THE CAUSES OF THE STRIKES WERE, RESPECTIVELY, FOR AN INCREASE OF WAGES AND CONCERNING THE RECOGNITION OF THE UNION AND UNION RULES

YEAR	FOR AN INCREASE OF WAGES	CONCERNING THE RECOGNITION OF THE UNION AND UNION RULES	YEAR	FOR AN INCREASE OF WAGES	CONCERNING THE RECOGNITION OF THE UNION AND UNION RULES
1881	73.62	40.74	1894	31.04	75.84
1882	56.86	50.00	1895	37.11	74.19
1883	74.31	17.50	1896	62.15	68.78
1884	57.25	30.00	1897	40.92	92.17
1885	61.13	50.75	1898	60.60	87.67
1886	66.44	40.58	1899	53.06	62.43
1887	48.97	53.41	1900	37.60	31.66
1888	63.53	47.64	1901	53.92	57.26
1889	53.45	46.85	1902	56.29	55.14
1890	45.64	45.25	1903	46.98	66.48
1891	37.01	69.46	1904	39.22	36.60
1892	55.01	13.09	1905	45.73	43.83
1893	47.39	82.01			

Thus far it has been possible to establish that strikes for an increase of wages decreased in relative

[1] The equation to the general trend of the successful strikes for an increase of wages is $y = 52.45 - .8614\,x$; and for the recognition of the union, $y = 53.55 + .9848\,x$, the origin in both cases being in the middle of the year 1893.

importance in the interval 1881–1905; that the percentage of successful strikes for an increase of wages decreased during the same period; that during the same epoch there was an increase in the relative number of strikes for the recognition of the union and an increase in the percentage of successful strikes for the recognition of the union. Furthermore, it has been established that the percentage deviations from the general trend are inversely correlated both in case of the relative importance of the two causes of strikes and in case of the percentage of successful strikes due to the two causes.

In view of the dominant importance of these two causes of strikes and of their interrelation, it is clear that if the outcome of strikes for either cause could be shown to be dependent upon economic law, a large part of the theory of strikes would be brought into intimate and real relation with the general theory of distribution.

Table IX has been compiled from the data contained in M. François Simiand's work: *Le Salaire des ouvriers des mines de charbon en France.* On pages 351–365 of that work M. Simiand has given the results of strikes relative to wages and conditions of work in the coal mining districts of the basins of *Loire*, *Nord*, and *Pas-de-Calais*. I have computed, for these three districts, in Chapter III, on "Wages and the Productivity of Labor," the equation to the general trend of the ratio of wages to the value of the product per laborer per day, and I have given the percentage

deviations of these ratios, for each year, from the general trend, during the period 1848–1901. By means of these two bodies of results Table IX has been constructed. The 112 strikes recorded by M. Simiand have been classified according as they fall into the sixteen subcontingency groups of the table.

TABLE IX.—Contingency between the Rate of Wages and the Outcome of Strikes

		Percentage Deviation of Wages from the General Trend				Total
		Above +4	0 to +4	0 to −4	Below −4	
Outcome of Strikes	Successful	3	5	12	7	27
	Very Favorably and Favorably Compromised		1	5	1	7
	Compromised	6	1	11	2	20
	Failed	18	10	26	4	58
Total		27	17	54	14	112

When the coefficients of contingency are computed, it is found that $C_1 = .327$ and $C_2 =$ between .36 and .37. The conclusions are—

(1) The outcome of strikes for the causes affecting wages or the conditions of work is

related to the deviations from the general trend of the ratio of wages to the value of the product, that is to say, the outcome of strikes affecting wages and the conditions of work is likely to be favorable or unfavorable to the interests of the laborers according as the prevailing share of the laborer in the value of the product is below or above the general trend of that share;

(2) The measure of this relation is $C_1 = .327$; $C_2 = .36–.37$.

But the above coefficients relate to M. Simiand's entire number of strikes between the years 1848–1901. The causes of the tabulated strikes were, however, mixed causes. M. Simiand has included all causes affecting wages and conditions of work, and consequently such causes find their place in his table as payment for supplies, hours of work, employment of foreigners, conduct of overseers, and dismissal of workmen. But we have established that the outcome of strikes varies according to the causes of strikes, and therefore it is desirable to narrow the investigation and to inquire whether there is any relation between the rate of wages and the outcome of strikes for an increase of wages.

Table X has been compiled from M. Simiand's data by including only those strikes that had their origin in a demand for an increase of wages. The material has been treated by the Pearsonian method for evalu-

ating the correlation ratio when one variable is given by alternative categories and the other by multiple categories. The percentage deviations from the general trend of the ratio of wages to the value of the product per laborer have been assumed to conform to the normal law.

TABLE X. — Correlation between the Rate of Wages and the Outcome of Strikes for an Increase of Wages

		Outcome of Strikes			Total
		Succeeded	Succeeded Partly	Failed	
Wages	Above general trend	3	1	10	14
	Below general trend	8	6	11	25
Total		11	7	21	39

The value of the correlation ratio is $\eta = .370$, which is the highest degree of relation that we have found in this chapter. The conclusions are (1) that the outcome of strikes for an increase of wages is related to the deviations from the general trend of the ratio of wages to the value of the product per laborer; (2) the degree of the relation is measured by $\eta = .370$. The outcome of a strike for an increase of wages is likely to be favorable to the interests of the laborers when the ratio of wages to the value of the product per laborer is below the general trend of that ratio. The outcome is likely to be adverse to the interests of the laborers when the prevailing ratio is above the general

trend. The general trend itself, as we discovered in the chapter on "Wages and the Productivity of Labor," is conditioned by the degree and nature of the organization of capital and labor in production.

Summary.

In beginning this chapter it was assumed that both labor organizations and economic law affect the outcome of trade disputes as to wages, and the scientific task that was imposed was to measure, as far as possible with available data, the relative importance of the two factors in the determination of the resulting rate of wages. The conclusions of the investigation may be summarized under two headings; (*A*) The influence of labor organizations; (*B*) The influence of economic law.

(*A*) The influence of labor organizations.

(1) The results of strikes ordered by labor organizations are more favorable to the interests of the laborers than the results of strikes that are not ordered by labor organizations. The measure of association between the outcome of strikes and the calling or not calling of strikes by labor organizations is given by $\eta = .218$.

(2) The greater the degree in which labor organizations control the trade disputes of an industry, the more likely is the outcome of a strike declared by labor organizations to be favorable to the interests of laborers.

The measure of association between the degree in which labor organizations control trade disputes and the outcome of strikes declared by labor organizations is given by $C_1 = .232$.

(3) The greater the duration of a strike, the less likely is its outcome to be favorable to the interests of the laborers. The measure of association between the duration of strikes and the nature of the outcome of strikes is $C_1 = .22$ in case of Germany, and $C_1 = .16$ in case of France.

(*B*) The influence of economic law.

The relations summarized under (*A*) must not be assumed to be relations of cause and effect. The low coefficients measuring the degrees of association preclude any inference as to causal relations. Moreover, the results are aggregate results of mixed causes and mixed conditions. A complete investigation would require a segregation of the material and its treatment according to differing conditions and causes. The results of this preliminary study, which goes as far in the direction of segregation of materials as the present sources will admit, are as follows: —

(1) The outcome of strikes is associated with the kinds of causes for which strikes are undertaken. The coefficient measuring the degree of association is $C_1 = .298$.

(2) The causes of strikes may be ranked according as they have been the origin of strikes that succeeded, succeeded partly, or failed.

(3) The most important causes of strikes have been "for an increase of wages" and "for the recognition of the union and union rules."

(*a*) The general trend of the ratio of strikes "for an increase of wages" to total strikes has been downward; the general trend of the ratio of strikes "for the recognition of the union" to total strikes has been upward.

(*b*) The general trend of the ratio of successful strikes "for an increase of wages" to total strikes "for an increase of wages" has been downward; the general trend of the ratio of successful strikes "for the recognition of the union" to total strikes "for the recognition of the union" has been upward.

(*c*) There is an inverse correlation between the percentage deviations from the general trend of the ratio of strikes "for an increase of wages" to total strikes, and the percentage deviations from the general trend of the ratio of strikes "for the recognition of the union" to total strikes.

(*d*) There is an inverse correlation between the percentage deviations from the general trend of the ratio of successful strikes "for an increase of wages" to total strikes "for an increase of wages," and the percentage deviations from the general trend of the ratio of successful strikes "for the recognition of the union" to the total strikes "for the recognition of the union."

This intimate connection of the two most important causes of strikes led to the attempt to connect one of the causes with the economic laws that have been established in a preceding chapter. It was found that —

(4) The results of strikes for general causes affecting wages and conditions of work are associated with the percentage deviations of the laborer's share of the product from the general trend of that share. The outcome of a strike for general causes affecting wages and conditions of work is likely to be favorable to the interests of the laborers when the laborer's share in the product of industry is below the general trend of that share. The outcome of the strike is likely to be adverse to the interests of the laborers when the laborer's share is above the general trend.

The coefficient measuring the association is $C_1 = .327$.

(5) The outcome of a strike "for an increase of wages" is related to the percentage deviation of the laborer's share of the product from the general trend of that share. The result is likely to be favorable if the laborer's share is below the general trend; it is likely to be adverse, in the contrary case. The measure of the relation is $\eta = .370$.

This last coefficient is based upon a small number of cases and consequently the probable error is high. From the nature of the data examined there is reason for supposing that, with a larger number of cases, the correlation ratio would be much higher.

CHAPTER VI

WAGES AND THE CONCENTRATION OF INDUSTRY

"Il mettere in luce l' influenza dell' impresa e dell' età dell' operaia sull' altezza dei salari, ci sembra ricerca della maggiore importanza teorica e pratica."

— *La Donna Nell' Industria Italiana*, p. ix.

The investigation upon which we are about to enter as to the influence upon the status of the laborer of the concentration of industry in large establishments is of both theoretical and practical importance. Its practical value lies in the answer to the question as to whether the form of selection of laborers entailed by the survival in competition of large establishments places the employees upon a better plane of living than the one occupied by their fellow-workers in smaller establishments. Its theoretical interest lies in the answer to the query as to whether the productivity hypothesis will explain the results to which the investigation will lead.

We shall approach our problem by considering the relation of the size of the establishment (1) to the rate of wages, (2) to the amount of employment, (3) to the continuity of employment, and (4) to the length of the working day.

Because of the complexity of the undertaking, there is great likelihood of obtaining spurious re-

sults in consequence of the mixing of heterogeneous data. The following cautions should be observed as far as possible in selecting material upon which to base the investigation: Data should be segregated (1) referring to different sexes; (2) referring to laborers of different ages; (3) according as the data are drawn from different geographical districts; (4) according as they are drawn from city and country; (5) referring to industries bearing the same generic name but producing different commodities. Unfortunately, statistics appropriate to the solution of difficult economic problems cannot be had for the asking, so that, in the treatment of several points in this chapter, I have been compelled to use data that do not in all respects fulfill ideal requirements.

Wages as Affected by the Concentration of Industry.

The first three tables in the Appendix to this chapter refer to the daily wages of women, above fifteen years of age, employed in the manufacture of textiles in Italy.[1]

We obtain,

(1) from Table I, the coefficient of mean square contingency between the size of the establishment and the rate of wages,

$$C_1 = .318;$$

[1] The tables in this chapter that present Italian data are drawn from the publication of the Ufficio del Lavoro: *La Donna Nell' Industria Italiana*, Roma, 1905.

(2) from Table II, the coefficient of mean square contingency between the rate of wages and the age of the worker,

$$C_1 = .25;$$

(3) from Table III, the coefficient of mean square contingency between the age of the laborer and the size of the establishment,

$$C_1 = .06.$$

With these crude coefficients of contingency, it would be possible to evaluate, by the method of multiple contingency, the net relation between wages and the size of the establishment. But such a net coefficient would not be an adequate index of the real connection between the phenomena. The details of the computation of the above coefficients have made it abundantly clear that the interrelations between the size of the establishment, the rate of wages and the age of the laborer cannot be sufficiently described by the simple linear laws that are obtained in the usual cases of correlation.

Let us first endeavor to find the law of the variation of wages with the age of the laborer.

Tables I and II of the text have been computed from Table IV of the Appendix.[1] Knowing the mean ages of the laborers in the separate wage groups and the mean wages earned by laborers in the same

[1] Table IV of the Appendix was copied from the publication, *La Donna Nell' Industria Italiana*, pp. 99–100.

TABLE I.—Mean Daily Wages of Italian Women according to their Ages and the Sizes of the Establishments in which they were at Work

Age of Employees	Mean Daily Wages received in Establishments with			
	Less than 20 Employees	20–99	100–499	500 and Over
15–20	.87	.93	1.04	1.24
20–35	1.09	1.10	1.21	1.50
35–55	1.05	1.12	1.17	1.48
Above 55	.92	.98	.98	1.16

TABLE II.—Mean Ages of the Employees in the Several Age Groups of the Four Classes of Establishments. Textiles. Italy.

Size of Establishment	Age Groups				
	Above 15	15–20	20–35	35–55	Above 55
Less than 20 employees	28.23	17.32	25.82	44.43	58.20
20–99	25.63	17.30	25.33	44.72	57.53
100–499	25.14	17.30	25.22	44.89	57.58
500 and Over	24.32	17.31	25.34	43.63	57.49

groups, we can deduce the approximate law of the variation of wages with the age of the laborer. Figure 18 is the graphical description of the variation of wages with the age of the female workers, above

fifteen years of age, engaged in the manufacture of textiles in Italy. The four curves upon the chart give the variation of wages with the age of the laborer, for the establishments of different sizes.

The curves show: —

(1) That the law of the variation of wages with the age of the laborer is, in general character, the same in establishments of different sizes: There is a rapid rise of wages to a maximum, between twenty-five and thirty-five years of age, and a slow descent to old age.

(2) That the larger the establishment the higher the wages at all ages. (This may be partly due to the fact that data from the whole of Italy were mixed in the summary table that has been used.)

(3) That in case of the smaller establishments — establishments "less than 20 employees," and between "20 and 99 employees" — the wages of the old employees are higher than the wages of the young employees, while the contrary is true of the larger establishments. (Compare the columns in Table I of the text.)

(4) That the descent from the maximum wage is more rapid in the large establishments.[1] (Compare the curves in Figure 18.)

[1] The above method and conclusions are submitted as contributions to Professor Max Weber's problem: "Es ist eine der wichtig-

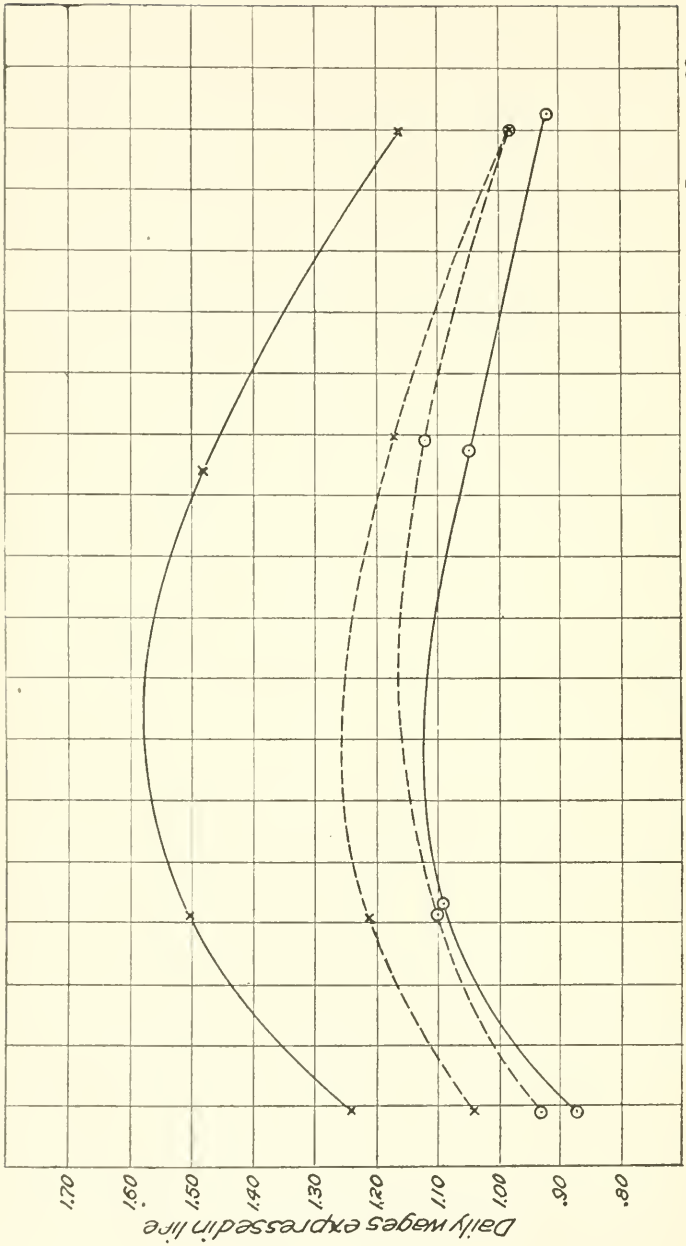

FIGURE 18. — Law of the variation of wages with the age of the laborer. Establishments with less than 20 employees, o—o; between 20 and 99, o---o; between 100 and 499, x---x; 500 and over, x—x.

Why should the law of the variation of wages with age take this peculiar form? Why should there be a rapid rise to a maximum between twenty-five and thirty-five years of age and a slow descent to old age? And why should the graphs descriptive of the operation of the law in the four classes of establishments be disposed in the same order as the sizes of the establishments? The productivity hypothesis supplies the proper answer to all of these questions.

We shall consider first the bearing of the productivity hypothesis upon the shape of the age-wage curve. In Chapter IV we found that the efficiency of the laborer is dependent upon a balance of physical, mental, and moral qualities, and that the wage of the laborer is dependent upon his industrial efficiency. In the present chapter we have discovered the law of the variation of wages with the age of the laborer. If the productivity hypothesis be the true explanation of wages, it would follow that the efficiency of the laborer — his balance of physical, mental, and moral qualities — must vary with age in a manner similar

sten Aufgaben, für die einzelnen Industrien, innerhalb ihrer die einzelnen Arbeiterkategorien und für diese wieder nach den einzelnen ethnischen, sozialen und Berufs-Provenienzen festzustellen: wie schnell oder langsam sie ein solches Mass von Leistungsfähigkeit erlangen, dass ihre Verwendung als Vollarbeiter rentabel wird, wann sie den Höhepunkt ihrer Leistung erreichen, wie lange sie sich auf dieser Höhe behaupten, und wann ihre Leistungsfähigkeit so weit sinkt, dass sie nicht mehr als Vollarbeiter, oder schliesslich überhaupt nicht mehr für die betreffende Arbeitsart verwendbar sind." "Zur Psychophysik der industriellen Arbeit," *Archiv für Sozialwissenschaft und Sozialpolitik*, 1909, pp. 270–271.

to the variation of wages with age: it must rise rapidly to a maximum between twenty-five and thirty-five years of age and then descend slowly to old age. There can be very little doubt, I think, that among the mass of laborers industrial efficiency varies with age according to this law. The study of certain physical measurements is confirmatory of this belief.

In a paper by A. O. Powys on "Data for the Problem of the Evolution in Man,"[1] the following important truths are discovered: —

(1) The law of the variation of stature with age, in case of the experience of New South Wales, is that stature increases rapidly from the age of fifteen to a maximum between twenty-five and thirty years of age and then decreases slowly to old age. (The maximum stature of men is reached at about twenty-eight years of age and of women at about twenty-five.)

(2) "The modal fertility of Victorian women is at 27 and of Victorian men at 32. For New South Wales women the modal fertility 24.4, two to three years less than for Victoria. We have not the data for New South Wales men, but they would probably show a mode of about 29–30 instead of 32. Thus we see that the age of maximum fertility at any rate approaches, if it does not coincide with, the age of most fully developed stature. As

[1] *Biometrika*, Vol. I, pp. 30–49.

> Mr. Powys remarks, this tendency of maximum stature age to coincide with that of maximum fertility can hardly be fortuitous. It seems probable that in man, as in other types of life, the age of maximum fertility is the age of most fully developed physique."[1]

The law of the variation of wages with age is therefore similar to the law of the development of physique, and both fertility and industrial efficiency reach their maxima, in the mass of laborers, at about the period of most fully developed physique. This resemblance in the general character of the law of the development of physique and the law of the variation of wages with age, together with the approximate coincidence of the periods of fully developed physique, maximum fertility, and maximum industrial efficiency leaves very little room for doubt as to the intimate causal relation of the phenomena. The facts are all in harmony with the *a priori* doctrine that the laborer's income is dependent upon his efficiency, and that consequently the law of the variation of his income is similar to the law of the variation of his efficiency.

We may now consider the manner in which the productivity hypothesis supplies the answer to the question as to why the graphs descriptive of the variation of wages with the age of the laborer are disposed

[1] Remarks of Professor Pearson upon Mr. Powys' data, *Biometrika*, Vol. I, p. 48.

upon the chart in the same order as the sizes of the establishments.

Two points may be made: —

(1) The large establishments select the more efficient laborers. Referring to the payment of higher wages in large establishments, the French report *Salaires et durée du travail dans l'industrie française* makes the following observation: —

> "Cette tendance ne se manifeste pas seulement en faveur des industries qui, comme les mines, les usines métallurgiques, les compagnies de transport, sont le terrain propre de la grande industrie: *on l'observe encore dans d'autres groupes où les grands établissements compensent, par des avantages économiques certains, la contrainte morale que la concentration des entreprises impose à la population ouvrière, laquelle ne renonce pas sans regret à la vie plus irrégulière, mais en un sens plus indépendante, de l'ancienne industrie.*"[1]

(2) Because of the use of large fixed capital in large establishments, the more efficient workers are more valuable to the large than to the small establishments.

> "We have hitherto supposed that it is a matter of indifference to the employer whether he employs few or many people to do a piece of work, provided his total wages-bill for the work is the same. But that is not the case. Those workers who earn most in a

[1] Vol. IV, p. 22. I have italicized the part of the quotation that I wish to emphasize.

> week when paid at a given rate for their work are those who are cheapest to their employers (and ultimately to the community, unless indeed they overstrain themselves, and work themselves out prematurely). For they use only the same amount of fixed capital as their slower fellow workers; and, since they turn out more work, each part of it has to bear a less charge on this account. The prime costs are equal in the two cases; but the total cost of that done by those who are more efficient, and get the higher time-wages, is lower than the total cost of that done by those who get the lower time-wages at the same rate of piece-work payment." "This point is seldom of much importance in out-of-door work, where there is abundance of room, and comparatively little use of expensive machinery; for then, except in the matter of superintendence, it makes very little difference to the employer, whose wages-bill for a certain piece of work is £100, whether that sum is divided between twenty efficient or thirty inefficient workers. *But when expensive machinery is used which has to be proportioned to the number of workers, the employer would often find the total cost of his goods lowered if he could get twenty men to turn out for a wages-bill of £50 as much work as he had previously got done by thirty men for a wages-bill of £40.*"[1]

We infer from the quoted facts that the higher wages paid in the larger establishments are due to the greater productivity of a personnel which, age for age, is superior in a balance of physical, mental, and moral qualities.

[1] Marshall: *Principles of Economics*, 4th edit., pp. 631–632. The part of the quotation that I wish to stress I have italicized.

The next detail to be examined is that of the differences in the age grouping of the operatives in large and in small establishments. The curves descriptive of the frequency distributions according to the age of the employees in establishments of different sizes may be deduced from Table IV of the Appendix. The method that I have adopted may be understood from the following illustration. Table IV gives the information that, in establishments employing at least 500 women, 41.9 per cent of the employees were between 15 and 20 years of age; 47.3 per cent between 20 and 35; 9.8 per cent between 35 and 55; and 1 per cent over 55. Assuming that no employee was over 65 years of age, the preceding age distribution may be expressed in cumulative form as follows: 100 per cent were over 15 years of age; 58.1 per cent over 20 years of age; 10.8 per cent over 35; 1 per cent over 55; and zero over 65. By fitting a parabola of the fourth order to the age distribution in the cumulative form, the equation to the age distribution is found to be

$$y = 7.167674 - .518268\,x + .028171\,x^2 - .0023708\,x^3 + .000064577\,x^4,$$

where, the origin being taken at 40, $(40 + x)$ represents the age and y the cumulative percentage frequency. By differentiating the equation and changing the signs of the quantities, the frequency distribution according to age is obtained in the usual form. The equation in the differential form is

$$y = .518268 - .056342\,x + .0071124\,x^2 - .0002583\,x^3.$$

From this latter equation, since the origin is at 40, the mean of the distribution may be found from $40+\frac{\int_b^a yx\,dx}{\int_b^a y\,dx}$ and the standard deviation of the distribution from $\frac{\int_b^a yx^2\,dx}{\int_b^a y\,dx}-\left[\frac{\int_b^a yx\,dx}{\int_b^a y\,dx}\right]^2$. Inasmuch as the lower age limit in the four groups of establishments is 15 years of age, b, the lower limit of integration, is -25. The upper limit of integration, a, is determined by the point where the curve cuts the axis of x and is different in the four types of establishments.

By utilizing this method, Table III of the text is derived.

TABLE III. — MEANS AND STANDARD DEVIATIONS OF THE AGES OF EMPLOYEES, ACCORDING TO THE SIZES OF THE ESTABLISHMENTS

	Size of Establishments			
	Below 20 Employees	20–99	100–499	500 and Over
Mean Age	28.23	25.63	25.14	24.32
Standard Deviation . . .	12.25	10.84	10.59	9.37

We see from this table that —

(1) the larger the establishment, the lower is the mean age of the employees;

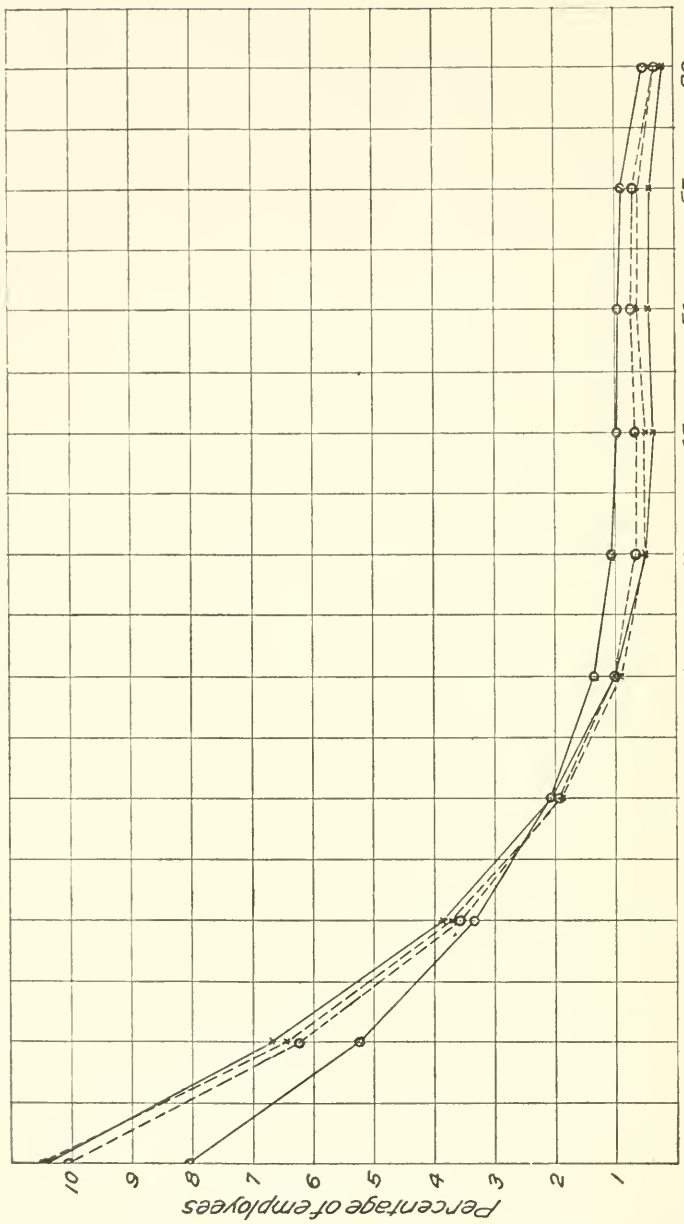

FIGURE 19.—The variation with age of the percentage frequency of employees. Establishments with less than 20 employees, o—o; between 20 and 99, o - - - o; between 100 and 499, x - - - x; 500 and over, x—x.

(2) the larger the establishment, the smaller is the "scatter" about the mean age.

It follows from these two facts that the bulk of the adult personnel in the four classes of establishments is younger, the larger the establishments.

In Figure 19 the percentage distribution of the operatives in the four classes of establishments is roughly indicated by a series of broken lines. The most marked feature of the graphs is that above forty years of age the percentage frequencies are in inverse order of the sizes of the establishments — the smaller establishments having at all ages above 40 a larger percentage of workwomen than the large establishments.

Amount of Employment.

We come now to the consideration of the relation of the size of the establishment in which laborers are at work to the amount of employment afforded by the establishments in the course of the year. We shall seek to know whether the mean number of days in which the laborers are employed in a year bears any relation to the size of the establishment in which they are at work. The material used in the investigation is again drawn from the admirable report, *La Donna Nell' Industria Italiana.*

In the Appendix, Table V, which was compiled from the Italian report, summarizes the data relating to the manufacture of textiles. From this Table V two contingency tables — Tables IV and V of the

TABLE IV. — Contingency between the Amount of Employment and the Size of Establishments. Textiles. La Donna Nell' Industria Italiana.

Mean Number of Days, per Establishment, worked in a Year	Number of Women in Establishments of Sizes given Below				Total
	Less than 20	20–99	100–499	500 and Over	
245–255	1167	25,007			26,174
255–265			62,930		62,930
265–275	999			6789	7788
275–285		3772			3772
285–295		3744	25,700		29,444
295–305			4936	16,269	21,205
Total	2166	32,523	93,566	23,058	151,313

text — have been constructed. Both of the contingency tables refer to the relation of the amount of employment to the size of the establishment, but they differ in respect to the system of weighting the amount of employment. The original Italian report [1] gives the number of establishments of various sizes, the mean number of days, per establishment, worked during the year by the establishments of the several sizes, and the total number of workwomen over fifteen

[1] Pages 54–62.

TABLE V. — Contingency between the Amount of Employment and the Size of Establishments. Textiles. La Donna Nell' Industria Italiana.

Mean Number of Days, per Establishment, worked in a Year	Number of Establishments of Sizes given Below				Total
	Less than 20 Employees	20–99	100–499	500 and Over	
245–255	116	613			729
255–265			462		462
265–275	123			11	134
275–285		92			92
285–295		99	130		229
295–305			27	26	53
Total	239	804	619	37	1699

years of age employed in the establishments of the several classes, on the 30th of November, 1903.

In the contingency Table IV, the mean number of days worked in a year, per establishment, is weighted in each case, with the number of workwomen employed in the establishments of the class in question, on the 30th of November, 1903. For example, 1167 women over 15 years of age were employed, on the 30th of November, 1903, in establishments in which the mean number of days' work, per establishment, in the preceding year, was between 245 and 255.

In the contingency Table V, the mean number of days worked in a year, per establishment, is weighted in each case with the number of establishments of the various sizes falling within the limits of the particular "days worked" group. For example, 116 establishments employing less than 20 women each worked on the average between 245–255 days, in the year from December 1, 1902, to November 30, 1903.

When the coefficients of contingency are calculated in the usual way from these two tables, we find that —

(1) in the first system of weighting, Table IV,

$$C_1 = .791\,;\ C_2 = .89\,;$$

(2) in the second system of weighting, Table V,

$$C_1 = .785\,;\ C_2 = .88.$$

These very high coefficients are marked indications of the gains to laborers, in the way of amount of employment, that accrue in consequence of the superior management necessitated by the investment of vast capital in enterprises producing upon a large scale.

Continuity of Employment.

The third aspect of our problem as to the relation of the status of the laborer to the size of the establishment in which he is employed is concerned with the variability of the amount of employment in course of the year. It has just been proved that the larger the establishment, the greater the amount of annual employment. We now inquire as to whether the

amount of employment afforded by the establishments of the various sizes is more or less variable, from month to month, in the larger establishments than in those of the smaller types.

Table VI of the text, referring to the manufacture of textiles in Italy, was summarized from the report that has proved so valuable in the other investigations of this chapter. It gives, for establishments of various sizes, the monthly indices of employment, in the more important subdivisions of the textile industry, together with the minimum, mean, and maximum monthly variations, in the year December 1, 1902, to November 30, 1903.

The method of presenting these results is due to Professor Bagni,[1] who had charge of the preparation of the report, *La Donna Nell' Industria Italiana*. Before commenting upon the data of Table VI, we shall consider the method of computing the monthly indices of employment.

For every establishment investigated, the Italian Bureau of Labor had data showing, for each month in the year December 1, 1902, to November 30, 1903, the number of days in which the establishment was in operation and the mean daily number of workwomen who were employed. It was, therefore, possible to compute for each class of establishments the total number of workwomen-days-work in each month. For, obviously, the number of workwomen-days-work in establishment X during the month Y

[1] *La Donna Nell' Industria Italiana*, p. ix.

TABLE VI. — Monthly Indices of Employment, Minimum, Mean, and Maximum Variations, considered in Relation to the Size of Establishments. Textiles. Italy, 1902–1903

Size of Establishments (Number of Employees)	Monthly Indices of Employment												Variations of the Monthly Indices		
	Dec.	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Minimum	Mean	Maximum
	The Manufacture of Silk														
Less than 20	94.9	101.2	94.0	99.8	96.7	98.4	80.9	100.2	108.2	109.7	110.0	106.0	.2	5.9	19.1
20–99	91.5	96.6	97.2	106.6	103.4	91.0	64.4	109.3	110.9	109.0	115.2	104.9	2.8	9.9	35.6
100–499	88.6	96.4	98.9	107.2	105.9	95.6	58.0	115.2	113.0	105.9	112.2	103.1	1.1	10.4	42.0
500 and Over	93.0	100.9	95.6	95.4	103.2	101.2	90.0	112.2	101.4	99.5	103.4	101.2	.5	4.4	12.2

Less than 20	88.7	95.5	86.5	96.4	96.2	99.8	94.4	108.7	104.1	106.3	115.0	108.4	.2	7.1	15.0
20–99	92.9	98.3	93.0	99.6	100.2	99.3	94.8	106.6	100.0	101.7	109.6	104.0	.0	3.7	9.6
100–499	93.9	100.9	95.4	100.1	101.8	100.8	94.9	107.2	98.5	98.6	107.1	100.8	.1	3.1	7.2
500 and Over	94.9	98.5	91.9	98.9	100.8	100.4	96.7	107.0	100.7	101.0	107.9	101.3	.4	3.2	7.9
	The Manufacture of Wool														
Less than 20	96.6	101.4	94.0	97.8	93.0	99.6	91.2	104.7	102.0	102.8	111.3	105.0	.4	4.6	11.3
20–99	96.1	99.4	91.2	103.2	101.6	99.1	96.0	105.2	98.5	98.6	106.1	102.0	.6	3.0	6.1
100–499	95.9	101.6	93.1	100.6	100.0	99.5	94.4	106.9	101.1	99.6	106.7	100.3	.0	2.9	6.9
500 and Over	100.2	102.0	93.6	100.6	101.5	102.3	97.7	104.6	99.0	97.5	103.9	97.1	.2	2.5	6.4
	The Manufacture of Flax, Jute, Hemp, Etc.														
Less than 20	93.4	86.7	87.4	96.1	100.6	100.5	95.6	108.7	104.3	103.7	112.5	110.5	.5	6.8	13.3
20–99	92.4	96.5	92.8	98.9	101.0	98.2	94.6	104.6	101.8	102.5	111.3	105.4	1.0	4.4	11.3
100–499	90.2	95.4	89.2	100.3	101.9	105.0	96.1	109.9	102.8	101.0	107.6	100.6	.3	4.9	10.8
500 and Over	95.1	102.4	94.6	101.6	103.7	100.9	92.7	107.3	96.7	98.7	106.9	99.1	.9	3.8	7.3

was equal to the number of days the establishment was in operation multiplied by the average daily number of workwomen employed that month. By means of this method the number of workwomen-days-work in each of the four groups of establishments was computed for each month of the year and for the whole year. The monthly numbers were afterwards expressed as fractions of the corresponding annual numbers, and the fractions were then multiplied by 1200. The resulting numbers are Professor Bagni's monthly indices of employment. The maximum, mean, and minimum variations are measured from 100.[1]

We may now examine Table VI. By referring to the last two columns we observe that —

(1) As the size of the establishment increases, the general trend of the mean variations of the index of employment is downward. (The silk industry is an exception to the rule.)

(2) As the size of the establishment increases, the general trend of the maximum deviation is downward. (The silk industry is again an exception to the rule.)

(3) In all of the groups, the mean deviation and maximum deviation in the largest establishments are smaller than the corresponding deviations in the smallest establishments.

[1] The objection to this method is that spurious monthly differences are introduced in consequence of not taking into account the differences in the length of the calendar months. The defect in the method does not invalidate the inferences in the text.

Length of the Working Day.

The fourth aspect of the problem as to the relation of the status of the laborer to the size of the establishment in which he is employed is concerned with the length of the working day. Up to this point the researches of this chapter have been based upon the data relating to the textile industry in Italy. It would be highly desirable to have all of our conclusions bearing upon the concentration of industry relate to one industry at a given time and place. But

TABLE VII.—MEAN DURATION OF DAILY HOURS OF WORK, CONSIDERED IN RELATION TO THE SIZE OF ESTABLISHMENTS, IN THE MINES OF FRANCE PRODUCING COAL AND OTHER FUEL

LOCALITY	MEAN DURATION OF DAILY HOURS OF WORK ACCORDING AS THE ESTABLISHMENT HAD A NUMBER OF WORKMEN				
	Exceeding 999	From 500 to 999	From 100 to 499	From 25 to 99	From 1 to 24
Région Nord et Pas-de-Calais	8¾	9¼	9½		
Région Est	8¾		9		10½
Région Centre	9	9¼	9½	10	
Région Sud	9¾	9½	10		
Région Sud-Est		8½	10	9½	
Région Bouches-du-Rhône		8¼	8½		

I do not know of the existence of material presenting a classification, according to sizes of establishments, of the hours of labor in the manufacture of textiles in Italy.

In default of appropriate Italian figures, we may refer to the investigation embodied in the French report: *Salaires et durée du travail dans l'industrie française.* Table VII[1] is given as a favorable instance of the findings of the French statisticians. This table eliminates the differences in hours of labor arising from the differences in locality, and it clearly shows that as a general rule the hours of labor decrease as the size of the establishment increases.

The conclusion that is drawn from this illustration is the conclusion of the French report as to the general trend in the whole of the French provincial manufactures. The conditions of production in Paris are exceptional, and statistical study of the relation of the size of the establishment to hours of labor is rendered difficult because of the classification under the same name of industries that are radically different in character. "En province, au contraire, les fabrications sont plus courantes, les divers établissements groupés sous le même nom d'industrie forment des groupes plus homogènes. On peut même les étudier, et on observe nettement une amélioration des conditions du travail dans les grandes entreprises. Dans leur ensemble, la durée du travail est plus courte."[2]

[1] This table is taken from Vol. IV, p. 100. [2] *Ibid.*, p. 22.

We started out to find the relation of the concentration of industry to the changing status of the laborer, and we proposed to investigate that relation from the four points of view of (1) the rate of wages, (2) the amount of employment, (3) the continuity of employment, and (4) the length of the working day. Our investigation has yielded the definite result that, as the size of the establishment increases, the condition of the laborer improves in all directions — his wages rise, he is employed a greater number of days in a year, his employment varies less from month to month, and his hours of labor, per day, decrease.

We have found that the law of the variation of wages with the age of the laborer is similar in establishments of all sizes, and that the general character of the law has its explanation in the law of the developing physique and capacity of the laborer. The differences in the graphs representative of the law of the variation of wages with the age of the laborer in the four types of establishments are due to the large establishments selecting the more capable workers. The large establishments are able to carry out the work of selection because, in consequence of their large capital and better organization, they offer opportunities for the more capable laborers to reap the reward of their differential ability.

APPENDIX

TABLE I. — Contingency between the Daily Rate of Wages and the Size of the Establishment in which Employees were at Work. Textiles. Italy.

Rate of Wages in Lire and Centesimi	Number of Workwomen in Establishments with				Totals
	Less than 20 Employees	From 20–99	From 100–499	500 and Over	
Up to .50	150	545	1030	96	1821
.51–.75	443	6303	9356	1103	17,205
.76–1.00	873	12,863	30,523	3718	47,977
1.01–1.50	645	11,239	45,113	10,605	67,602
1.51–2.00	214	1843	7097	6396	15,550
2.01–2.50	30	519	1755	1482	3786
Over 2.50	6	177	613	413	1209
Totals	2361	33,489	95,487	23,813	155,150

TABLE II.—Contingency between the Daily Rate of Wages and the Age of the Laborer. Textiles. Italy.

Rate of Wages in Lire and Centesimi	Number of Employees whose Ages were in the Age-groups				Totals
	15–20	20–35	35–55	Above 55	
Up to .50	1425	228	105	63	1821
.51–.75	11,000	4063	1478	664	17,205
.76–1.00	21,903	18,843	6049	1182	47,977
1.01–1.50	24,905	33,884	8010	803	67,602
1.51–2.00	4184	9103	2109	154	15,550
2.01–2.50	555	2511	676	44	3786
Above 2.50	98	807	289	15	1209
Totals	64,070	69,439	18,716	2925	155,150

TABLE III. — Contingency between the Age of Employees and the Size of the Establishment in which they were at Work. Textiles. Italy.

Age in Years	Number of Workwomen in Establishments with				Totals
	Less than 20 Employees	20–99	100–499	500 and Over	
15–20	778	13,453	39,851	9988	64,070
20–35	1005	14,831	42,367	11,236	69,439
35–55	471	4543	11,367	2335	18,716
Over 55	107	662	1902	254	2925
Totals	2361	33,489	95,487	23,813	155,150

TABLE IV.—Classification of Workwomen according to their Ages, their Rates of Wages, and the Sizes of the Establishments in which they were employed. Textiles. La Donna Nell' Industria Italiana, pp. 99–100

Size of the Establishments	Percentage of Workwomen, over 15 Years of Age, receiving the following Rate of Wages. [Rates are expressed in Centesimi and Lire]								Age Groups
	Up to .50	.51–.75	.76–1.00	1.01–1.50	1.51–2.00	2.01–2.50	Above 2.50	Total Percentage	
Less than 20 Employees	4.0	8.5	12.1	7.0	1.3			32.9	15–20
	1.3	6.4	15.0	13.3	5.4	1.0	.2	46.6	20–35
	.5	3.0	8.2	6.0	2.1	.3		20.1	35–55
	.5	.9	1.7	1.0	.3			4.4	Above 55
	6.3	18.8	37.0	27.3	9.1	1.3	.2	100.0	
20–99	1.2	11.1	15.6	11.2	.9	.2		40.2	15–20
	.2	5.9	16.5	17.1	3.3	1.0	.3	44.3	20–35
	.1	1.6	5.4	4.8	1.2	.3	.2	13.6	35–55
	.1	.3	.9	.5	.1			1.9	Above 55
	1.6	18.9	38.4	33.6	5.5	1.5	.5	100.0	
100–499	.9	6.5	14.9	17.1	2.0	.2	.1	41.7	15–20
	.1	1.9	12.4	24.1	4.3	1.3	.4	44.5	20–35
	.1	.9	3.9	5.5	1.0	.3	.2	11.9	35–55
		.5	.8	.5	.1			1.9	Above 55
	1.1	9.8	32.0	47.2	7.4	1.8	.7	100.0	
500 and Over	.3	3.7	9.1	19.5	8.1	1.1	.1	41.9	15–20
	.1	.6	4.9	20.5	15.8	4.1	1.3	47.3	20–35
		.2	1.3	4.1	2.9	1.0	.3	9.8	35–55
		.1	.3	.5	.1			1.0	Above 55
	.4	4.6	15.6	44.6	26.9	6.2	1.7	100.0	

TABLE V. — The Manufacture of Textiles in Italy, considered with Reference to the Size of the Establishments, the Subdivisions of the Industry, the Mean Number of Days per Establishment worked in a Year, the Total Number of Employees and the Total Number of Establishments

	Size of Establishment															
	Less than 20 Employees				20–99				100–499				500 and Over			
Industry	Silk	Cotton	Wool	Flax, Jute, Hemp, etc.	Silk	Cotton	Wool	Flax, Jute, Hemp, etc.	Silk	Cotton	Wool	Flax, Jute, Hemp, etc.	Silk	Cotton	Wool	Flax, Jute, Hemp, etc.
Mean Number of Days per Establishment worked in a Year	247	267	268	271	250	283	291	289	257	293	296	293	267	300	304	299
Total Number of Employees over 15 Years of Age	1167	337	353	309	25,007	3772	1830	1914	62,930	21,692	4936	4008	6789	12,085	1998	2186
Total Number of Establishments	116	40	48	35	613	92	45	54	462	109	27	21	11	19	3	4

CHAPTER VII

CONCLUSIONS

"Womit wir es hier zu thun haben, ist eine kommunistische Gesellschaft, nicht wie sie sich auf ihrer eigenen Grundlage entwickelt hat, sondern umgekehrt, wie sie eben aus der kapitalistischen Gesellschaft hervorgeht; die also in jeder Beziehung ökonomisch, sittlich, geistig, noch behaftet ist mit den Muttermalen der alten Gesellschaft, aus deren Schoos sie herkommt."

— Karl Marx.

In the preceding chapters we have been concerned entirely with the scientific aspects of the subjects that came before us, and no attempt was made to indicate the practical bearing of the results that were established. But the economist, least of all scientists, can feel content with the simple understanding of the laws of his subject matter. He desires to see what guidance they may afford in the complicated life of his own time. This summary will, accordingly, be concerned primarily with the relation of our results to actual practice.

We may notice first the practical character of Statistical Economics. It was pointed out in the first chapter that in its scientific character, Statistical Economics proposes this twofold object: (1) to bring to the test of representative facts the hypotheses and theorems of pure economics; (2) to supply

data, in the form of general facts and empirical laws, for the elaboration of dynamic economics. Its practical service is performed in a similar way; for, in giving a statistical summary and interpretation of the material relevant to the economic subject under investigation, it supplies the means by which general reasoning may be brought to bear upon the problems of industrial legislation. A short account of the way in which this form of economic science has come into being will indicate more clearly its scope and bearing.

Just half a century ago, in an inspiriting address[1] on "The Progress of Economic Science during the Last Thirty Years," William Newmarch summarized what he regarded as the greatest achievement of the science during the period covered in his survey.

"Looking back at the changes and the experience of which this is a rapid outline, it appears to me that I shall not be in any danger of misleading the Section if I suggest that probably the most conspicuous and important fact to be found in the history of Economic Science during the last thirty years is this; namely, that while there has been no change in the objects to which it is directed — no change in the purposes intended to be worked out — while these objects and these purposes remain the same in their broad and general aspect as they have been from

[1] Newmarch gave the address as President of Section (F) of Economic Science and Statistics of the British Association for the Advancement of Science. The address is published in the *Journal of the Statistical Society*, 1861, pp. 451–467.

the time of Adam Smith, there has been a marked change in the Methods according to which Economic Science is cultivated. It has ceased to be an abstract science,— it has ceased to be a system of subtle and ingenious reasonings. It has little by little, and by a process cautious and full of promise, become a science almost entirely experimental. We have learned that in all questions relating to human society — in all controversies where the agency of human beings has to be relied upon for working out even the smallest results — we have learned that in these inquiries the only sound basis on which we can found doctrines, and still more the only safe basis on which we can erect laws, is not hypothetical deduction, however ingenious and subtle, but conclusions and reasoning supported by the largest and most careful investigation of facts. This vital change of method, this substitution of observation and experiment (and for our present purpose the two words mean very much the same thing) for deductions arrived at by geometrical reasoning, seems to me to be the most prominent fact of the last thirty or forty years, as regards the progress of the branches of knowledge which more immediately interest us in this Section."

The negative attitude of Newmarch with regard to theoretical economics I, of course, do not share. The quotation has been made in order to stress his point of view as to the relation of economic science to legislation. The two pervading ideas of the address are,

first, that effective legislation must be based upon experience, and, secondly, that experience must be interpreted by the statistical method: "we claim for Statistics . . . that it is the application of the Experimental or Baconian method to the several divisions of inquiry which relate to man in society. We say that where there is no careful application of the Statistical method — in other words, where there is an absence of observation and experiment, so far as observation and experiment can be applied to men in Societies — there can be but faint hope of arriving at the truth in any line of research connected with social problems." [1]

In the works of Stanley Jevons is found the development of the ideas of Newmarch upon this subject. Jevons observed that legislation in England did not proceed without what is commonly called statistical evidence, but the statistics were not always of the right sort, nor were the statistical inquiries always conducted according to "true scientific method." [2] Furthermore, using the hint in Newmarch's address, he called the method of legislation he approved "Baconian legislation," and he thus described the principle upon which it should proceed: "What I venture to maintain is that Baconian legislation will always proceed by reasoning from the most nearly proximate and analogous experience which is avail-

[1] Newmarch: *Journal of the Statistical Society*, 1861, p. 457.

[2] Essay on "Experimental Legislation and the Drink Traffic." *Methods of Social Reform*, p. 256.

able. *We cannot possibly dispense with general reasoning, but we should use it as sparingly as possible. We should choose, as it were, the lowest logical elevation in sight.*" [1]

The part of the quotation that I have italicized presents the point of view I should like to urge. According to the argument of the chapter on "Statistical Laws," the statistical economist proceeds by a progressive synthesis from individual facts to general facts, and from general facts to statistical laws. He expresses the laws in their mathematical form, and, where it is possible, he measures the degrees of association between the related phenomena, expressing them as coefficients of correlation, correlation ratios, or coefficients of contingency, as the case may be. Now in Baconian legislation, the interpretation by means of general economic reasoning of the statistical laws and coefficients of association constitutes "the lowest logical elevation in sight" upon which legislation can be effectively based. The practical work of the statistical economist bridges the gap between general reasoning and the crude facts.[2]

[1] Jevons: *The State in Relation to Labor*, p. 21.

[2] This conception of Statistical Economics, theoretical and applied, is receiving a most promising development in the contemporary Italian school, whose organ of publication is the *Giornale degli Economisti*. Following Professor Pareto's attempt to give concreteness to the theory of distribution by basing his reasoning upon a statistical law summarizing approximately the distribution of income in modern societies, numerous essays appeared, particularly in Italy, in which Pareto's method was applied in the treatment of other social phenomena. Professor Pareto himself, asserting, in 1907, that "the progress of political economy in the future will depend in great part upon the investi-

Coming now to the detailed consideration of the practical bearing of the preceding chapters, we may observe with reference to the two theories, which for the sake of brevity we may refer to as the subsistence theory and the standard of life theory, that their persistence in economic literature gives color to the belief that wages may be increased in other ways than through an increased effective productivity of the laboring class. This is particularly true in regard to the doctrine of the standard of life, because in support of false views, Ricardo's authority may be cited: "The friends of humanity cannot but wish that in all countries the labouring classes should have a taste for

gation of empirical laws that are derived from statistics" (*Giornale degli Economisti*, Maggio, 1907, p. 366), has spent much of his time in perfecting the inductive, statistical tool by means of which the empirical laws are summarized in mathematical form.

But the formal conception of an Inductive Economics, utilizing as means of investigation modern statistical methods, is found in the work of Professor Benini and of Professor Bresciani. In his inaugural address as Professor of Statistics in the University of Rome, Professor Benini outlined his conception of "Una possibile creazione del metodo statistico. L'economia politica induttiva" (*Ibid.*, Gennaio, 1908). His volume on *Principii di Statistica Metodologica* may be regarded as his description of the method to be employed in the treatment of this aspect of economic science. More recently, Professor Bresciani, in his inaugural address as Professor of Statistics in the University of Palermo, has treated a phase of the same subject under the title "Sul carattere delle leggi statistiche" (*Ibid.*, Marzo, 1910). In the series of articles on correlation and frequency distributions, published in 1909, Bresciani has described to his co-workers the methods of Professor Karl Pearson. A marked indication of the influence of this constructive group of younger economists is seen in the change in the name of their journal. Since 1910, the title of this admirable review is no longer simply *Giornale degli Economisti* but *Giornale degli Economisti e Statistica*, thus establishing a formal attempt to bring theoretical and statistical economics into intimate relation.

comforts and enjoyments, and that they should be stimulated by all legal means in their exertions to procure them." [1] It is entirely possible with ingenuity to interpret Ricardo's meaning from the context so that it would seem to be in harmony with the modern doctrine, but, without doubt, the vigorous statement is both misleading and false: misleading, in consequence of wrong emphasis in centering attention upon increasing wants while ignoring the inevitable price of their gratification; and false, in consequence of lumping together the "laboring classes," and inferring that it is true of all grades of labor that there should be an artificial stimulation of wants.

In order to seize the degree of truth in either of the two theories that we are considering, it is necessary to reason about laborers not as a class that may be represented as a whole by a more or less fictitious "average laborer," but as made up of groups which, in regard to wages, may possibly be subject to different laws or to different degrees of effectiveness in the working of the same law.

If, with this conception, we begin our investigation by considering the two theories with reference to their relevancy to the groups of skilled and of unskilled laborers, we are brought to practical conclusions of considerable importance: —

(1) It cannot be said that in the territory covered by our figures the wages of unskilled laborers

[1] Ricardo: *Principles of Political Economy and Taxation*, McCullochs' edit., p. 54.

are determined by the cost of the means of subsistence, that is to say, a fixed mode of life. This negative statement is *a fortiori* true of the wages of skilled laborers;

(2) There is a close correlation between the wages of unskilled laborers and their standard of life, but the correlation is not so high as to justify the inference of a cause and effect relation;

(3) The correlation between the wages of skilled and of unskilled laborers is much higher than the correlation of the wages of unskilled laborers with their standard of life.

These facts, which are inductively established, lead to the following reflection: the wages of both skilled and of unskilled laborers are determined by other causes than the adherence of the laborers to a fixed mode of subsistence or to a variable standard of life. The chief determining cause is the specific productive efficiency of each group, as is illustrated in Chapter III: the efficiency of the unskilled group yields a wage that affords a variable standard of life, and because of the great supply of labor of this character, both the wage and the standard of life vary within narrow limits. The wages of the skilled group are likewise dependent upon the specific productive efficiency of the skilled group, but, because of the opportunity enjoyed by employers in an open market of substituting, within limits, unskilled for skilled labor,

the strategic advantage of skilled laborers is affected by the wage received by unskilled laborers, as is indicated in Chapter IV. It is submitted that these facts have a fundamental bearing upon the theory of wages, upon the conception of the solidarity of industry, and upon all projects having in view the bettering of the state of the laboring class by the establishment of a legal minimum wage with the necessary concomitant regulation of the supply of unskilled labor.[1]

The idea of the solidarity of industry receives increased illumination from the conclusions of the chapter on "Wages and the Productivity of Labor." It was there established —

(1) that average wages increase with the specific product of labor;

(2) that the more rapid the increase of capital in the industry, the more rapidly do wages increase;

(3) that the fluctuations of wages about their general trend are inversely correlated with the machine-power with which the laborers work. It is true that these points were established only with reference to the one industry for which we could obtain adequate data, but there is the great satisfaction of knowing that the inductive findings with regard to this one industry are in complete

[1] Cf. *The Minority Report of the English Poor Law Commission*, 1909.

accord with the conclusions of *a priori* reasoning.

The very high coefficients of correlation measuring the relation between the variables that figure in these three propositions compel the acceptance of the idea of solidarity which sympathetic supporters of the cause of the laborers too frequently ignore. It is clearly indicated that one of the most valuable services that can be rendered by labor organizations consists in using their power to induce and compel the highest possible efficiency of plant and industrial organization. The resulting increased productivity will supply the fund from which increased wages may be obtained, and a permanently increasing wage can be secured only by increasing the flow of the specific products of labor.

It has been said that the results of Chapter III compel the acceptance of the idea of solidarity of industry. It is not useless to add that this does not by any means suggest that the present form of solidarity is the best that is conceivable. There is a perplexing statement in this connection in Professor Clark's *Distribution of Wealth*:[1] —

"For nothing, if not to protect property, does the state exist. Hence a state which should force a workman to leave behind him in the mill property that was his by right of creation, would fail at a critical point. A study of distribution settles this question, as to whether the modern state is true to its principle. Property is protected at the point of its origin, if actual wages are the whole product of labor, if interest is the

[1] Page 9.

product of capital, and if profit is the product of a coördinating act."

When this introductory statement was followed by the admirably lucid and cogent proof with which we are familiar that each factor in production does tend to get what it produces, one could scarcely avoid a sense of baffled enthusiasm in recalling the words that have just been quoted.

Of course the solution of the difficulty lies in the apprehension that the introductory statement and the argument take for granted the present forms of ownership of property and the present social and technical conditions of production. It is entirely conceivable that a form of distribution of property which when tested by any familiar standard of equity would be pronounced inequitable, could coexist with each factor in production tending to get what it produced. The social and technical conditions of production might coöperate to reduce the national dividend to a minimum and still that minimum would be distributed according to the specific productivity of the several factors.

The same difficulty takes a visible form in the treatment of the problem of production and distribution by a series of simultaneous equations, as, for example, that problem is treated by Professor Marshall[1] and Professor Pareto.[2] The problem of distribu-

[1] Marshall: *Principles of Economics*, 4th edit. Appendix, particularly notes XIV, XXI.

[2] Pareto: *Cours d'économie politique.* Vol. I, *Principes d'économie politique pure.*

tion is shown to be determinate if the following facts are known: (1) the effective demand schedules of the members of the community, which result from their desires and their wealth; (2) the supply schedules of the factors of production, which result from the amounts of the factors in existence and the needs and dispositions of their possessors; (3) the functions descriptive of the technical conditions of production, which depend upon the state of invention and the legal and other social conditions under which industry is carried on. Whatever may be the character of the functions of these three items, it is shown that under the hypothesis of least cost or of perfect competition, each factor will tend to get what it produces. But that fact is not assumed by either Professor Marshall or Professor Pareto to be any justification of the particular forms that may be assumed by the functions.

This observation brings us to a perception of the further practical bearing of the results of Chapter III. In order that the problem of distribution of income may be determinate, it is necessary that the number of equations in the problem shall be equal to the number of unknown quantities. Now a considerable number of the necessary equations are dependent upon the proof that under free competition, or the hypothesis of least cost, each factor in production gets what it produces, and the results of our chapter show that so far as labor is concerned this tends to be the fact in the present industrial organization of society. That is to say, an important part — but

only a part, let it be understood[1]—of the momentous problem of the organization of industry and the distribution of income is worked out as it should be in the present industrial society.

This point is of extreme importance, and its significance should not be misunderstood. There are two distinct questions[2] in the theory of the socialization of the means of production: (1) as to whether it is socially expedient for the state to assume control of any particular form of the means of production, and (2) as to the principles upon which the ministry of production in a collectivist state should organize and carry on industry with the means of production placed at its disposal. Postponing the discussion of the first question until we come to the consideration of the

[1] Marshall: *Principles of Economics*, 4th edit., p. 588.

"Subject to conditions which are indicated in the foot-note, but are not important for our main purpose, the wages of every class of labour tend to be equal to the net product due to the additional labour of the marginal labourer of that class.

"This doctrine has sometimes been put forward as a theory of wages. In reply to any such pretension, it may be objected that the doctrine that the earnings of a worker tend to be equal to the net product of his work, has by itself no real meaning; since in order to estimate net product, we have to take for granted all the expenses of production of the commodity on which he works, other than his own wages.

"But though this objection is valid against a claim that it contains a theory of wages, it is not valid against a claim that the doctrine throws into clear light the action of one of the causes that govern wages."

[2] In this paragraph, I follow Professor Barone, who, utilizing the suggestions of the earlier work of Pareto, has given a mathematical demonstration of the proposition under discussion, in his substantial articles on "Il ministro della produzione nello stato collettivisto," which were published in the *Giornale degli Economisti*, 1908, pp. 267–293; pp. 391–414.

results of another chapter, we may observe that if in a collectivist state the minister of production should seek to maximize the national dividend of the community, he must so apportion the means of production that their marginal productivity shall be the same in different forms of production, and he must place values upon the units of the several factors that are proportionate to their respective marginal productivities. The latter principle of valuation is the principle of reward according to specific productivity that tends to be realized in the present industrial state.

In reviewing the results established in the chapter on "Wages and Ability," we shall see that they lend additional force to what has just been said. I should like first, however, to amplify an idea to which reference was made a moment ago. In summarizing the results of the chapter on "Wages and the Standard of Life," the importance of distinguishing in theory between the qualities of different groups of laborers was dwelt upon. One of the invaluable services that the newer statistical methods are likely to render to pure economics is to liberate speculation from the bondage to the average in which it has labored since the beginning of the science.

The syndicalist Georges Sorel has shown how, influenced by the special conditions of production in the large manufacturing industries of England and by the prevailing forms of physical science, the nineteenth century economists disregarded the qualities

that differentiate laborer from laborer and conducted their reasoning with regard to "units of labor" and "laborers of average capacity."

"On arriva ainsi à penser que, dans l'industrie la plus avancée, il devenait inutile de tenir compte des qualités propres des hommes et qu'on pouvait considérer les travailleurs comme des atomes de qualité moyenne, susceptible d'être seulement distingués par des grandeurs mathématiques, en sorte que toute l'économie devînt une science des quantités de travail mises en jeu par les capitalistes."[1]

The most marked development of science in the latter half of the nineteenth century took its departure from the study of deviations from the average rather than of the average itself, and economists will, of course, adjust their theories in the light of this newer evolutionary science. There can be little doubt that egalitarian doctrines of the past century were fostered through the inadequate method of reasoning by vaguely conceived averages and the ignoring of the law of the natural differences between individuals in any large group.

That there is a law of natural differences between individuals in any large group, no one who is acquainted with the results of recent biometric and anthropometric work will deny. The point that concerns us, however, as practical economists is to know whether this law of natural differences finds its expression in the actual earnings of laborers. According to the productivity theory of wages the distribution of general wages among the groups making up

[1] Georges Sorel: *Introduction à l'économie moderne*, p. 29.

the class of laborers should be according to the productive efficiency of the respective groups. The results of our investigation have established that the law of the natural difference in ability between individual laborers does find its expression in the apportionment of earnings among laborers in the present industrial state, and that, furthermore, the congruence is remarkably close between the actual distribution of wages and distribution as it should be according to *a priori* theory.

As a rule, the curve descriptive of the distribution of wages among a large group of laborers employed in numerous occupations is skew in a positive direction. This skewness is generally, but not always, a sign of improving conditions in the laboring class. When the industry grows more productive and earnings are such as to justify an increase in wages, the more intelligent and better organized laborers are the first to perceive and to take advantage of the improved conditions. The more prompt adjustment of wages of the abler laborers to the increased productivity gives the wages curve a greater measure of skewness. The subsequent changes in the degrees of skewness are dependent upon the degree of friction in the adjustment of the wages of the less able laborers and upon the improving or declining general conditions of industry.

In a collectivist state conducted upon the principle of rendering a maximum the product of available labor and capital, the differences of earned incomes of the members of the state must conform to the very

same law that obtains in the present industrial order. It is a mark of the great progress in the scientific treatment of social questions that upon this fundamental point economist and socialist are in agreement. Writing under the influence of the idea of Marx that is quoted as the motto to this chapter, Sorel observes "que c'est par un mécanisme emprunté à l'ère capitaliste que le socialisme compte régler la répartition,"[1] and then, touching upon the question before us, he says: "Le capitalisme . . . tend à produire une certaine égalisation du travail entre les diverses parties de l'usine; mais comme il a besoin d'un nombre considérable d'hommes particulièrement actifs, attentifs ou expérimentés, il s'ingénie à donner des suppléments de salaire aux hommes qui lui rendent ainsi plus de services; ce n'est point par des considérations de justice qu'il se règle dans ce calcul, mais par la seule recherche empirique d'un équilibre réglé par les prix. Le capitalisme arrive donc à résoudre un problème qui semblait insoluble, tant qu'il avait été étudié par les utopistes; il résout la question de l'égalité des travailleurs, tout en tenant compte des inégalités naturelles ou acquises qui se traduisent par des inégalités dans le travail."

The only "socialist revolution" of which we have knowledge is the revolution in the opinions of leading "scientific socialists"[2] — their abandonment of

[1] Sorel: *La Décomposition du Marxisme*, p. 41.

[2] The right to refer to Sorel as a socialist can scarcely be denied in view of his claim to teaching *le Marxisme de Marx*.

their doctrine of the cataclysmal destruction of capitalism and their apprehension of the necessity of regulating distribution in a collectivist state by means of a mechanism borrowed from the capitalist era.

The most critical practical questions concerning the income of laborers are the questions as to the effect upon wages of strikes and of the concentration of industry in large establishments. It is by means of the pressure of labor organizations, which in its acute stage takes the form of strikes, that laborers expect to compel an increase of wages; and it is from the growing magnitude of the aggregations of capital which tend more and more to control the output in the market that they expect to find their greatest opposition. These two subjects form the topics of our last two chapters, the results of which, as to their practical bearings, we shall consider in sequence.

Since the attitude of the public toward industrial disputes, in the matter of public sympathy and public control, must change with the degree of relevant scientific information that is available, it will be well to consider our great progress during the last half century in the understanding of the nature, causes, and effects of strikes.

Fifty years ago the dominant school of economists was united in its insistence upon a vicious, radically fallacious doctrine of wages which contained as corollaries : —

(1) the doctrine of the impotence of trades-unionists to increase their wages through combinations and strikes;
(2) the doctrine of the impotence of laborers to increase their wages through the increase of their productive efficiency;
(3) the doctrine of the impotence of laborers to better their condition by exerting pressure, through combination, upon the employers to the end that they should increase the efficiency of their plant and organization.

This theory of wages was so hypothetical and so vague that it was impossible to put it to an inductive test. Indeed the nebulous character of the theory was one condition of its persistence; for, as soon as precision was given to the terms in which it was expressed, it was seen that the modicum of truth in the doctrine was but little more than a pedantic elaboration of a platitude.

The successful middle class that had risen in wealth and power during the period following the industrial revolution was predisposed, in consequence of its industrial interests, to accept the economic doctrine of the wages-fund with all of its corollaries. Accordingly, strikes and labor combinations were regarded as being impotent to achieve the effects sought by trades-unionists and as being, moreover, conspiracies against public order. In the meanwhile strikes increased in number and extent and bitterness of con-

flict, and, notwithstanding the enormous public interests at stake, no public authority concerned itself with the collection of adequate material bearing upon the origin, causes, and outcome of strikes, which material alone, when properly interpreted, could possibly afford guidance in the direction and control of this form of industrial warfare.

During the interval of fifty years, the progress in the understanding of the labor question has been such as to lead to a reversal of attitude upon all of these points. A new theory of wages, definite in form and admitting of empirical tests, has been developed as a part of a general efficiency theory of distribution. So far as its fundamental propositions have been tested it has been found that the theory tends to be realized in actual practice. The essential idea of the new doctrine is that, with a definite technical and social organization of industry, the laborer tends to get what he produces. Corollaries to the doctrine are: —

(1) that whatever leads to an increase in the efficiency of the worker will tend to increase his wages;

(2) that if increased wages do not follow upon increased efficiency of the industrial worker, the labor combinations can, through strikes, force the cession of the increased product;

(3) that without the increased efficiency no amount of striking will result in a permanent increase of wages;

(4) that labor organizations, through their powers of putting pressure upon the employer to increase the efficiency of his plant and organization, have a means not only of increasing wages, but of enlarging the national dividend.

Public opinion is in the process of adjusting itself to the new light. The vagaries of early economists have discredited *a priori* opinions as to industrial matters; it is insisted that economic truths like all other truths can be reached only by treating scientifically the relevant facts that are laboriously accumulated. Accordingly, in nearly all of the states of Europe, public bureaus have been established for the purpose of collecting and interpreting the facts bearing upon the labor question.

The material available at present is neither satisfactory in classification nor adequate in amount for a complete treatment of the question of strikes. But the results in Chapter V show —

(1) that the outcome of strikes is subject to statistical and economic laws;

(2) that the scientific apparatus in the form of economic theory and statistical mathematics has been developed to such a degree of power as to be equal to the handling of this complex problem;

(3) that there is reason for believing that if data of satisfactory quality and quantity were

supplied, the whole subject could be placed upon a scientific foundation admitting of the prediction of average results in a way that would approximate the actuarial calculations of life insurance.

Public opinion, as has been said, is adjusting itself to the newer light. Public opinion is unalterable in its condemnation of the form of industrial treason that is manifested in a general strike. Its condemnation is unalterable because there is absolute certainty that no economic service rendered by the aggrieved class is comparable to the economic loss that would follow upon a tolerated general strike. Public opinion is in sympathy with or in opposition to strikers according as it is made clear that the strikers have or have not created a value that is appropriated by the employer. It would therefore seem obvious that since public opinion does utilize the degree of knowledge that is available, and since adequate scientific knowledge could be supplied, if only the facts were properly collected and analyzed, we should not be far from the solution of a problem that many have regarded as insoluble. Our progress during the last fifty years justifies this belief; the importance of the question justifies the exertion of any degree of pressure upon an industrial group that should either withhold the facts, or pollute the sources of knowledge for the purpose of exploiting an opportunity created by public ignorance or misinformation.

In the matter of the attitude of the state toward economic activities, we have made the distinction[1] between the question (1) as to what forms of capital should be socialized, and (2) as to the principles that must be followed by a collectivist minister in the direction of production and distribution. With regard to the latter question it has been shown to be demonstrable that, if a collectivist state is to have any degree of stability, the principles followed in the apportionment of labor and capital in production and in the distribution of the product of industry must be the same in the collectivist state as in the present industrial state, and that when recent socialist thinkers have attempted to give definiteness to their proposals for collective control and administration, they admit this fact. We have further shown that when competition tends to be realized — in the technical sense of the word competition — or when through collective bargaining results approximating competitive standards are reached, the presumption is against any attempt at socialization of the industry concerned.

The results of Chapter VI on "Wages and the Concentration of Industry" will throw some light on the first of the two questions into which we have divided the problem of socialization; viz., what forms of capital should be socialized. As we have shown that the presumption is in favor of the present order of production when competitive standards are

[1] Barone made the distinction in 1908 in his articles on "Il ministro della produzione nello stato collettivisto."

realized, it is quite clear that the ground for belief in the expediency of socializing any form of concentrated industry must be found in the deviation of the facts of industry where concentration obtains from the standards that would be realized under competitive conditions. We are therefore led to inquire in what respect, so far as the laborer is concerned, do the facts of industry where masses of capital and labor are aggregated differ from the facts where labor and capital coöperate in the same industry upon a smaller scale. Concentration of industry, in the sense in which the term is used here, viz., of aggregation of capital and labor in the same establishment, does not by any means imply the abrogation of competition. But it is a normal form of transition from competition to monopoly and for that reason deserves especial investigation.

The researches of Chapter VI have been undertaken with a view to discovering the effects of concentration of industry upon the status of the laborer. The broad general results of the chapter are[1] —

[1] A technical detail affecting the comparison of the wages received in large and in small establishments is of sufficient importance to justify a note.

When such comparisons are made, spurious differences that are due to several causes are obtained. A common form of spurious differences has its origin in the lumping together of wage statistics from different geographical districts, as, for example, when the wages paid in the manufacture of cotton in the northern and southern states of the United States are massed in a classification of rates of wages according to the size of establishments (cf. *Earnings of Wage-earners, Census of Manufactures*, 1905, Bulletin 93, pp. 73–81). In this case, a comparison between the mean rate of wages in large establishments

(1) That as regards the four critical items — rate of wages, amount of employment, continuity of employment, and length of the working day, the status of the laborer improves with the increasing concentration of industry;

(2) That the greater complexity of production following upon the concentration of labor and capital creates new opportunities for efficient laborers to exploit their differential ability;

(3) That, when the degree of the concentration of industry increases, the similarity and the differences in the operation of the law of the variation of wages with the age of the

and the mean rate in small establishments would show a difference in favor of large establishments. But this difference would be spurious so far as concerns the effect of the size of the establishment upon the rate of wages. The fact that the large establishments are situated in greater number in the northern states where a high rate of wages prevails would be an explanation of a difference in the rate of wages paid in the large and in the small establishments.

A more subtle form of spurious difference is manifested when wage statistics are presented without reference to the age grouping of the laborers. That is to say, increasing concentration of industry implies a form of industrial selection of laborers which shows itself, in one way, by the different age groupings of laborers in large and in small establishments.

The constants in the equation expressing the law of the variation of wages with age vary not only with the degrees of concentration of capital and labor in the same industry but also from industry to industry. In both cases these variations should be taken into account before comparisons are instituted between the rates of wages in different industries and in establishments varying in size in the same industry. It is suggested that in the presentation of wage statistics a plan should be followed similar to the procedure of the English Registrar General, in his comparison of death rates in different places where the age groupings of the populations are different.

o

> worker are explicable by means of the hypothesis that the laborer tends to earn an income proportionate to his efficiency in production.

These inductive findings not only reënforce the belief that, so far as the welfare of the laborer is concerned, concentration of industry is no ground for the socialization of industry, but they place in clearer light the solidarity of industry and illustrate how the increasing welfare of the laborer is dependent upon the skillful management of large capital.

We finally reach our question as to what forms of capital or economic institutions should be socialized, meaning by socialization the administration in the common interest of society. We need a principle upon which to make the decision, and we need a method by which each institution may be put to the test of our principle.

In our quest of a principle we may start from two propositions which I think will be accepted by both economist and socialist. We may assume first, that, so far as it is compatible with the acquisition of better things, it is desirable to have the national dividend of wealth a maximum; and, secondly, that those who take part in the creation of the dividend should receive shares that are proportionate to their contribution to the total product. Our principle is implicit in these propositions, and it may be worded as follows: the economic resources of a state should

be so utilized as to render the national dividend of wealth the maximum that is compatible with the acquisition of better things, and the dividend should be so distributed that each contributor to its production should receive a share proportionate to his services.

The method of applying this test of an efficient economy is a combination of synthetic economics[1] and statistical economics. We have shown in an earlier part of this chapter that, according to recent economic theory, the problem of production and distribution of wealth is determinate, if we admit the hypothesis of least cost or of perfect competition and have a knowledge of three facts: (1) the effective demand schedules of the members of the community, which result from their desires and their wealth; (2) the supply schedules of the factors in production, which result from the amounts of the factors in existence and the needs and dispositions of their possessors; (3) the functions descriptive of the technical conditions of production, which are dependent upon the state of invention and the legal and other social conditions under which industry is carried on. Starting from this hypothesis and the knowledge of these three facts, it may be proved *that under the assumed conditions the national dividend is a maximum and the owners of the factors of production are re-*

[1] Barone refers to the type of economic theory in which the conditions of production and distribution are simultaneously presented in a series of equations as *L'economia sintetica.*

warded with shares proportionate to the contributions of the several factors to the production of the dividend.

The words that are italicized in the preceding description are critical for the application of the test of an efficient economy. The test requires that the resources of the state shall be so utilized as to render the national dividend the maximum that is compatible with the acquisition of better things, whereas in the above economy, the national dividend is rendered a maximum under the assumed rights of ownership of the factors of production and the existing technical, legal, and other social conditions of production. Furthermore, the test requires that the individuals in the community should receive shares of the dividend proportionate to their contributions in its production, whereas the above economy cedes to the owners of the factors of production shares proportionate to the contributions of the factors. Whether, in these two points, there is a great or small discrepancy between the ideal and the actual depends upon the concrete form of the premises upon which the theory rests. It is the task of synthetic economics to supply a general solution of the problem as to the effects upon the size of the national dividend and its resulting distribution of any alteration in the hypotheses or the premises upon which the theory rests. It is the task of statistical economics to give concrete form to the premises and the general solution by summarizing in mathematical form the relevant facts in the present order of production and distribution.

THE following pages contain advertisements of a few of the Macmillan publications on kindred subjects

The Law of the Employment of Labor

By L. D. CLARK

Cloth, 12mo, $1.60 net

In all the realm of economics it is strange that heretofore no book has been published dealing specifically and authoritatively with the legal aspects of labor. Mr. Clark has realized this, and his book covers the whole field of law as it affects the employment of labor in the United States. By the citation of an adequate number of representative cases and statutes, the principles of common law in their most important phases as well as the nature and trend of legislation are discussed and illustrated in so far as these are applicable to workmen and their employers.

By SCOTT NEARING, Ph.D.

Of the Wharton School, University of Pennsylvania

Social Adjustment

Cloth, 377 pages, $1.50 net

"It is a good book, and will help any one interested in the study of present social problems." — *Christian Standard.*

"A clear, sane gathering together of the sociological dicta of to-day. Its range is wide — education, wages, distribution and housing of population, conditions of women, home decadence, tenure of working life and causes of distress, child labor, unemployment, and remedial methods. A capital reading book for the million, a text-book for church and school, and a companion for the economist of the study desk."

— *Book News Monthly.*

Wages in the United States

Cloth, 12mo, $1.25 net

This work represents an examination of statistics offered by various states and industries in an effort to determine the average wage in the United States. As a scholarly and yet simple statement it is a valuable contribution to the study of one side of our social organization.

THE MACMILLAN COMPANY

Publishers **64-66 Fifth Avenue** **New York**

PRINCIPLES OF ECONOMICS

By F. W. TAUSSIG

Henry Lee Professor of Economics in Harvard University

Cloth, 8vo, 2 volumes, $4.00 net per set

This book, which is addressed neither to specialists nor to children, but to students and the educated public, states simply but fully the main principles of economics and their application. It does not avoid difficult or severe reasoning, but centers attention on the larger problems and the important trains of reasoning and treats these liberally and fully. The book deals with the present day; there is very little of economic history, very little about the phenomena of semi-civilization or barbarian society. The experiences and problems of countries of advanced civilization are primarily kept in view. American problems naturally receive considerable attention, but the author is chiefly concerned with those principles which are of general application in all of the leading countries of modern times.

ECONOMICS

By SCOTT NEARING and FRANK D. WATSON

Both instructors in Political Economy in the Wharton School of Finance and Commerce, University of Pennsylvania

Cloth, 8vo, 493 pages, $1.90 net

The book discusses the whole subject of prosperity of the factors which enter into the complex economic life of the nation. A young man who wishes to read even the daily paper with full intelligence would find time spent in reading this book well employed for the help which it would give him in understanding current discussions of such topics as the standard of living; the natural resources of the country and their conservation; the relations of labor and immigration; of the labor of women and children to industrial progress; of organization in business and its tendencies; of the growth and functions of large corporations; of public ownership; of the various experiments which have been tried at different times, or the programmes which social leaders are now proposing for the remedy or the prevention of economic injustice.

THE MACMILLAN COMPANY

Publishers **64-66 Fifth Avenue** **New York**

Law for the American Farmer

By JOHN B. GREEN, of the New York Bar

Decorated cloth, xvi + 438 pp., index, $1.50 net; by mail, $1.63

"A volume that bears the marks of painstaking effort to present information that will be useful to those engaged in agriculture. In no sense is the book intended to take the place of counsel, but merely to fit the owner of a farm to cope with legal questions which may arise any day in the conduct of his farm. Any person who will make himself familiar with the contents of this book will possess a liberal education." — *Boston Globe.*

A Living Wage: Its Ethical and Economic Aspects

By Rev. J. A. RYAN. *Cloth, 12mo, $1.00 net; by mail, $1.12*

"A clear and concise study of the wage problem."

The Labor Movement in America

By RICHARD T. ELY. *12mo, half leather, $1.25 net*

A historical and critical sketch of the struggle of the day-by-day working population of North America for the betterment of their condition.

Labor Problems

By THOMAS S. ADAMS and HELEN L. SUMNER

8vo, cloth, gilt top, $1.60 net

"Invaluable as presenting in convenient and accessible form necessary material that would else have to be searched for in widely scattered sources." — *Providence Journal.*

Federal Power over Carriers and Corporations: A Study of the Sherman Anti-Trust Law

By E. PARMALEE PRENTICE. *12mo, cloth, $1.50 net*

This is an exhaustive study of the Sherman Anti-Trust Act and of the Federal powers upon which the Act is based.

THE MACMILLAN COMPANY

Publishers **64-66 Fifth Avenue** **New York**

Wage-Earning Women

By ANNIE MARION MacLEAN

Professor of Sociology in Adelphi College

Cloth, leather back, 12mo, $1.25 net; by mail, $1.35

"This book needed to be written. Society has to be reminded that the prime function of women must ever be the perpetuation of the race. It can be so reminded only by a startling presentation of the woman who is 'speeded up' on a machine, the woman who breaks records in packing prunes or picking hops, the woman who outdoes all others in vamping shoes or spooling cotton. . . . The chapters give glimpses of women wage-earners as they toil in different parts of the country. The author visited the shoe-shops, and the paper, cotton, and woollen mills of New England, the department stores of Chicago, the garment-makers' homes in New York, the silk mills and potteries of New Jersey, the fruit farms of California, the coal fields of Pennsylvania, and the hop industries of Oregon. The author calls for legislation regardless of constitutional quibble, for a shorter work-day, a higher wage, the establishment of residential clubs, the closer coöperation between existing organizations for industrial betterment."

— *Boston Advertiser.*

Making Both Ends Meet:

The Income and Outlay of New York Working Girls

By SUE AINSLIE CLARK and EDITH WYATT

Illustrated, cloth, 12mo, 270 pages, $1.50 net; by mail, $1.60

The girl who, without friends or home, is obliged to earn her living in a big city, faces a very real problem. Various phases of this problem have been dealt with by philanthropic, social and religious workers and writers, but the solution is seemingly as far away as ever. Though there are many homes and organizations of a semi-charitable nature in all our large cities, these really can care for and watch over but a small per cent of the working girl population. Those who for one reason or another do not come within the radius of these institutions must shift entirely for themselves. These are the subjects of Mrs. Clark and Miss Wyatt's book.

THE MACMILLAN COMPANY

Publishers **64-66 Fifth Avenue** **New York**

American Social Progress Series

EDITED BY

PROFESSOR SAMUEL McCUNE LINDSAY, PH.D., LL.D.,

COLUMBIA UNIVERSITY

A series of handbooks for the student and general reader, giving the results of the newer social thought and of recent scientific investigations of the facts of American social life and institutions. Each volume about 200 pages.

1 — **The New Basis of Civilization.** By SIMON N. PATTEN, PH.D., LL.D., University of Pennsylvania. *Price*, $1.00 *net.*

2 — **Standards of Public Morality.** By ARTHUR TWINING HADLEY, Ph.D., LL.D., President of Yale University. *Price*, $1.00 *net.*

3 — **Misery and Its Causes.** By EDWARD T. DEVINE, Ph.D., LL.D., Columbia University. *Price*, $1.25 *net.*

4 — **Government Action for Social Welfare.** By JEREMIAH W. JENKS, Ph.D., LL.D., Cornell University. *Price*, $1.00 *net.*

5 — **Social Insurance.** A Program of Social Reform. By HENRY ROGERS SEAGER, Ph.D., Columbia University. *Price*, $1.00 *net.*

6 — **The Social Basis of Religion.** By SIMON N. PATTEN, Ph.D., LL.D., University of Pennsylvania. *Price*, $1.25 *net.*

7 — **Social Reform and the Constitution.** By FRANK J. GOODNOW, LL.D., Columbia University. *Cloth*, 12*mo*, $1.50 *net.*

THE MACMILLAN COMPANY

Publishers **64-66 Fifth Avenue** **New York**